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October 1980

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SEVENTH ANNUAL REPORT

GREAT LAKES WATER QUALITY

SUMMARY AND RECOMMENDATIONS

This Report marks the transition between the Commission's activities under the 1972 Great Lakes Water Quality Agreement (GLWQA) and those under the 1978 Agreement.

The Report gives an overview and a lake-by-lake description of the water quality in the Great Lakes Basin during 1978 with an indication of some broad changes that have occurred since 1972, and provides comments and recommendations stemming from an assessment of progress under the 1972 Agreement. A range of problems arising from industrial and municipal dischargers to the Lakes are addressed, including toxic and hazardous substances and hazardous waste disposal; phosphorus and eutrophication; the long range transport of airborne pollutants, and radioactivity. Finally, the Report deals with the topics of Great Lakes surveillance, Commission institutions and new directions under the 1978 Agreement.

Industrial and Municipal Remedial Programs

Programs under the 1972 Agreement emphasized the control of conventional pollutants such as phosphorus, BOD and phenols from industrial and municipal point sources. Considerable progress has been made in reducing the inputs of these pollutants to the Lakes. The implementation of certain programs has been delayed or otherwise constrained, however, by legislative, regulatory, funding or enforcement inadequacies as will be pointed out in this Report.

The Commission, noting that many improvements have been made since 1972 to the legislative and regulatory base in both countries, recommends that:

- all jurisdictions ensure continued progress towards implementing pollution control programs so that action can be taken where needed to deal with dischargers having remedial programs that are incomplete or inadequate to meet the Purpose and the General and Specific Objectives of the 1978 GLWQA.

Pollution control agencies in both countries have stated policies, to various degrees, concerning the use of the Specific Objectives of the 1978 Agreement as a basis for water quality standards or control requirements. Nevertheless, the Commission urges the Parties to the Agreement to ensure that:

- all jurisdictions use the General and Specific Objectives of the 1978 GLWQA as minimum requirements in granting discharge permits or similar approvals.

The Commission believes that the great expense of the current industrial and municipal programs to both governments and industry, and the need for adequate data to assess progress under the GLWQA, justify a complete inventory of all point source dischargers, including substances and quantities discharged, and their pollution abatement requirements. The Commission therefore recommends that governments:

- provide a complete inventory of all point source dischargers in the Basin in the preparation of the inventory of pollution abatement requirements called for in Article VI of the 1978 Agreement.

Although the progress in municipal waste treatment in the Great Lakes Basin has been encouraging, the Commission is of the opinion that the performance of many plants can be enhanced with improved operation and maintenance practices. The Commission therefore recommends that:

- steps be taken to ensure the improved efficiency in treatment that can be achieved by following optimum operating and maintenance procedures and by upgrading operator skills.

The Commission also notes that a number of major U.S. municipal wastewater treatment plants, particularly Detroit, Cleveland and Toledo, have remained behind schedule in completing required works, and recommends that:

- every possible effort be undertaken to complete programs for the abatement and control of dischargers of municipal wastewaters to the Great Lakes System.

Phosphorus and Eutrophication

Eutrophication remains an important problem in the Great Lakes Basin. Nearly two-thirds of the population served by sewers in the United States portion of the Basin and almost all of the population served by sewers in the Canadian portion received adequate treatment in 1978. Nevertheless, phosphorus loads to Lake Erie and Lake Ontario, as well as loads to the Upper Lakes, remained well above the target loads established in the 1972 Agreement, due both to excessive municipal loads and to non-point sources of phosphorus.

The Commission repeats the concern raised in its Report On Pollution in the Great Lakes Basin from Land Use Activities regarding the interpretation of the phosphorus control goals in the 1978 Agreement and the tentative phosphorus target loads for Lake Erie and Saginaw Bay to meet these goals, and recommends that:

- Governments ensure that, in approving new municipal sewage projects, such projects can later be upgraded or modified if necessary to accommodate new phosphorus management strategies that may be considered following the Commission's further report on this matter.

Toxic and Hazardous Substances

The Commission again expresses its view that the control of toxic and hazardous substances within the Great Lakes System is a problem of high priority requiring the strict regulation of the manufacture, use, transport and disposal of such substances. The Commission therefore recommends that:

- Governments accelerate their efforts to develop and implement programs for the assessment and control of toxic and hazardous substances in the Basin;

- a coordinated hazard assessment methodology for man-made chemicals in the Great Lakes Basin be developed as soon as possible;

- high priority be given to research regarding the dispersal and fate of man-made chemicals in the environment and to legislative/regulatory action for their control;

- all jurisdictions assess the adequacy of their capability to identify, measure and analyze toxic and hazardous substances, and take the necessary measures to provide adequate laboratory facilities and skilled personnel to meet the analytical requirements of a comprehensive toxic and hazardous substances control program;

- the Information System for Hazardous Organics in a Water Environment (ISHOW) data base, developed by the Science Advisory Board (SAB), be provided with all necessary information on the manufacture, use and import of chemicals in both the United States and Canadian portions of the Great Lakes Basin; and

- the replacement of toxic and hazardous substances in the manufacturing process with less hazardous materials, and the reduction of wastes (through product modification, recycling, closed loop production systems or the neutralization of wastes), be vigorously pursued by industry and governments.

As such replacement and reduction may not be achieved in the near future, the Commission also recommends that:

- the Governments ensure that comprehensive systems of waste management be developed and implemented for the safe storage, transportation and disposal of hazardous wastes; and

- steps be taken to increase public understanding of the need for providing adequate and safe facilities and sites for the handling and disposal of such wastes, including adequate public demonstration that such sites are technically possible and environmentally safe.

Long Range Transport of Airborne Pollutants

Water quality and other ecological changes in the Great Lakes Basin have resulted from emissions to the atmosphere from many sources. The Commission recommends that the Governments:

- undertake further actions to reduce atmospheric emissions of the oxides of sulphur and nitrogen from existing as well as new sources; and

- ensure the expansion of research programs to provide information on the causes, effects and measures for the control of the long range transport of airborne pollutants, especially acid rain.

Surveillance

The Great Lakes International Surveillance Plan (GLISP) is undergoing review and modification by the Water Quality Board. Although it has yet to be reviewed by the Commission, the modifications will result in the expansion of GLISP from a plan primarily to assess nutrients to one that attempts to address a range of concerns, including toxic and hazardous substances, non-point sources and atmospheric inputs. A revised GLISP will require the development of new monitoring and surveillance programs, and improved sampling and analytical techniques. The Commission recommends that:

- Governments ensure that adequate funds are made available to prepare and implement their surveillance and monitoring programs called for in the 1978 GLWQA, and that such programs be modified to take into account the revised Surveillance Plan being developed by the Commission; and

- research and program assessment needs be closely coordinated in the implementation of the surveillance program in order to ensure the maintenance of expertise and to integrate research results into the further development and improvement of surveillance activities.

Environmental Mapping

Noting the activities of the Science Advisory Board's Task Force on Environmental Mapping, and concerns that have been expressed about environmental mapping, the Commission again recommends that:

- Governments sponsor an experimental environmental mapping project in order to determine the problems and benefits associated with such an undertaking.

1. INTRODUCTION - THE 1972 AND 1978 GREAT LAKES WATER QUALITY AGREEMENT

This is the Commission's Seventh Annual Report on Great Lakes Water Quality. It covers progress and activities during 1978, the last year that the 1972 Great Lakes Water Quality Agreement was in effect. Because this is the final report under the 1972 Agreement, an attempt is also made to evaluate progress under that Agreement.

The General Objectives of the 1972 Agreement for the Great Lakes System were, in effect, that the waters should be free from various substances entering the waters as a result of human activity to a degree that is unsightly or deleterious, creates a nuisance, adversely affects human, animal or aquatic life, or creates nuisance growths of aquatic vegetation. Specific water quality Objectives for the boundary waters of the Great Lakes System included objectives for microbiology, dissolved oxygen, total dissolved solids, taste and odour, pH, iron, radioactivity and phosphorus. The 1972 Agreement also included interim objectives calling for restrictions on temperature; mercury and other toxic heavy metals, and persistent organic contaminants toxic or harmful to human, animal or aquatic biota; settleable and suspended materials; oil, petrochemicals and immiscible substances. It recognized the concepts of non-degradation of areas where water was of better quality than the Specific Objectives, specified that regulatory agencies may designate restricted mixing zones in the vicinity of outfalls within which Specific Objectives shall not apply. The Agreement also recognized the existence of localized areas where existing conditions would prevent the objectives from being met, at least over the short-term, but which should not contribute to the violation of water quality objectives across the international boundary.

The 1972 Agreement specified that programs and other measures directed toward the achievement of the water quality objectives should, unless otherwise agreed, be either complete or in the process of implementation by December 31, 1975. They included:

(a) programs for the abatement and control of municipal sewage and industrial discharges into the Great Lakes;

(b) measures for the control of inputs of phosphorus and other nutrients, and

(c) measures for the abatement and control of pollution from agricultural, forestry and other land use activities, shipping sources, dredging activities, and onshore and offshore facilities.

The 1972 Agreement also called for the maintenance of a joint contingency plan for use in the event of the discharge, or threat of discharge, of oil or hazardous polluting substances, and for the development of an Annex to the Agreement which identifies hazardous polluting substances.

The initial emphasis under the 1972 Agreement was on finding solutions to the more obvious water quality problems. Accordingly, high priority was given to the implementation of effective industrial and municipal waste treatment and phosphorus removal facilities.

While encouraging progress has been made under the 1972 Agreement in some of these areas, as noted in previous annual reports of the Commission, much remains to be done. The further requirements for pollution control in the Great Lakes Basin are emphasized and given a revised perspective by the provisions of the 1978 Agreement.

The 1978 Agreement reaffirms the Parties' determination to restore and enhance water quality in the Great Lakes System. It is more comprehensive than the 1972 Agreement in its greater emphasis and specificity in addressing a wide range of issues and in recognizing the concept of the Great Lakes Basin as a unitary and interacting ecosystem. The experience and information gained under the 1972 Agreement has given the Governments a firm basis upon which to develop new and more effective actions to restore and enhance water quality in the Great Lakes Basin.

The Specific Objectives of the 1972 Agreement have been revised and expanded, and now number over forty in the 1978 Agreement. These objectives are based on available information on cause/effect relationships between pollutants and the ecosystem and on the principle of protecting the most sensitive beneficial use in the boundary waters.

A number of these new objectives were among these recommended in 1977 and 1978 by the Commission in special reports to the Governments. Four other objectives were referred back to the Commission for further study. These latter objectives (for chlorine, silver, temperature and cyanide) were subsequently referred to the Water Quality Board with the request that it make further recommendations to the Commission.

Again, recognizing that there would be local areas in the Basin where some of these objectives would not be met, the Parties made provisions in the 1978 Agreement, similar to those in the 1972 Agreement, to allow them to designate limited use zones in the vicinity of present and future municipal, industrial and tributary discharges. Specific criteria for the designation and review of these limited use zones, including their minimization, are contained in the 1978 Agreement, Annex 2. The Agreement set January 1, 1980, as the final date for designating limited use zones for industrial discharges and for municipal discharges in excess of 1 million gallons per day. This deadline was, however, not met in either Canada or the United States. The designation process in Canada was not completed by mid-1980, because of delays. In the United States, the Environmental Protection Agency (EPA) has expressed concerns about the legality of the designation of limited use zones in view of the requirements of the U.S. Clean Water Act which requires the elimination of discharges. The concept is still under review in the United States. Unless limited use zones are designated, the 1978 GLWQA appears to require that the Specific Objectives be met at the point of discharge to the boundary waters of the Great Lakes System.

The 1978 Agreement includes a commitment by the Parties to continue to develop and implement programs and other measures to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin ecosystem. The Parties thus committed themselves to the implementation of programs for the abatement, control and prevention of pollution from such diverse sources as dredging, shipping, forestry, agricultural, municipal and industrial activities. Final dates for the completion and operation of municipal and industrial programs are December 31, 1982 and December 31, 1983, respectively.

The Agreement incorporates measures designed to deal specifically with a number of serious Basin-wide problems. A commitment is made on the part of the Governments to "virtually eliminate" the discharge of persistent toxic substances into the Great Lakes System and to prohibit the discharge of toxic substances in toxic amounts, as well as to establish an early warning system to anticipate and prevent future toxic substances problems. Provisions are also included for programs to identify the sources and assess the effects upon water quality in the Great Lakes System of airborne pollutants, and for the Parties to consult on appropriate remedial programs. The Agreement also calls for a coordinated surveillance and monitoring program for the Great Lakes System.

In order to minimize eutrophication problems of the Great Lakes System, the 1978 Agreement outlines a number of programs designed to reduce municipal, industrial and non-point phosphorus inputs to the Lakes. Interim phosphorus loading objectives for each lake are contained in the Agreement. These objectives were subject to review and confirmation within 18 months of the November 1978 signing of the Agreement. This deadline was subsequently postponed to allow the Governments to consider also recommendations stemming from the Commission's Task Force on Phosphorus Management Strategies.

2. WATER QUALITY OF THE GREAT LAKES BASIN ECOSYSTEM

(i) Basin Overview

A review of water quality in the Great Lakes during 1978, on the basis of compliance with the General and Specific Objectives of the 1972 Agreement, resulted in the identification of 48 specific geographical areas having degraded water quality due to pollution from industrial, municipal or non-point sources. The number and status of these "Problem Areas" constitute one measure of how well the terms of the Agreement are being met. Problem Areas have been classified as to those in which:

(a) water quality objectives have not been met because remedial programs are incomplete;

(b) remedial programs are complete, but a delay is expected before lake conditions show improvement due to the long response time; or

(c) further remedial work may be required.

The Water Quality Board reported that of the 48 Problem Areas during 1978, 26 were in category (a), six in category (b) and 16 in category (c).

New Problem Areas were identified during 1978 in Lake Ontario at Clarkson, Ontario where high phenol concentrations in the water (16 mg/L) were observed, and in the St. Lawrence River at the mouth of the Grass River, New York, where elevated PCB levels in the water were detected. The Pine River, a tributary of the St. Clair River in Michigan, was removed from the list of Problem Areas because no fecal coliform violations (the reason it was on the list of Problem Areas) were noted during surveillance activities in 1978.

In its Sixth Annual Report, the Commission observed that since 1975 there has been no significant overall improvement in the status of these Problem Areas (Figure 1). There was, in fact, an

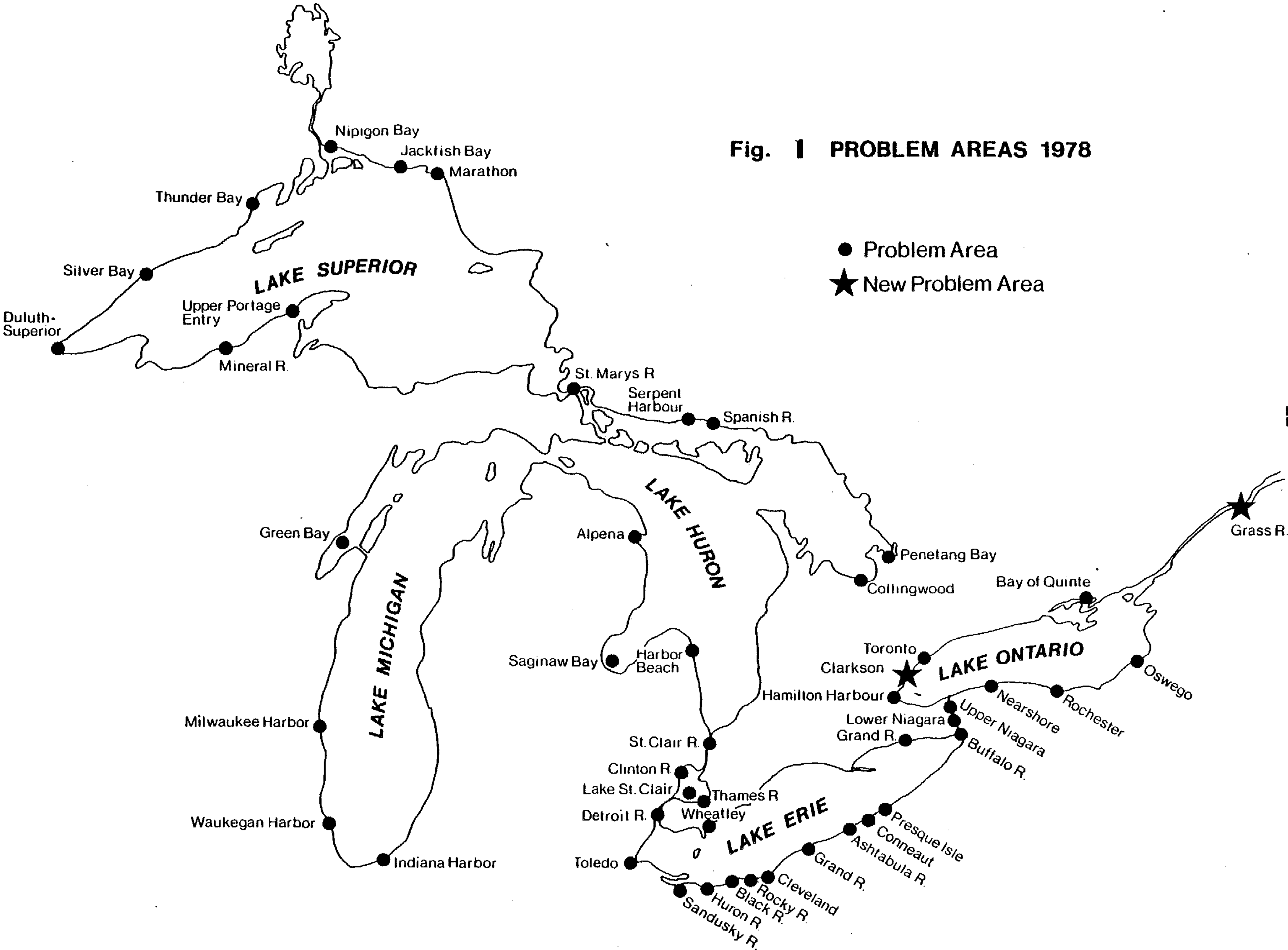

Fig. 1 PROBLEM AREAS 1978

increase of Problem Areas from 47 in 1977 to 48 in 1978. More than 170 separate major dischargers of both industrial and domestic sewage have been identified in the 48 Problem Areas. Of these dischargers, 54 did not meet their relevent 1978 effluent requirements, although remedial programs were either in place or scheduled for implementation. A review of the Water Quality Board's assessment of the adequacy of remedial programs leads to the conclusion that the completion of these programs should correct most of the problems pertaining to the identified dischargers, although in some cases only over a long period of time.

The Commission wishes to emphasize that the above Problem Areas are only those identified specific major areas ("hot spots") where the objectives of the 1972 Agreement were not being met. The expanded objectives and improved surveillance under the 1978 Agreement may well lead to the identification of additional areas of concern. Other pollution problems exist (e.g., persistent toxic substances, non-point sources, atmospheric inputs), however, that affect whole lakes or the entire Great Lakes System, and which are not evident from an examination of the Problem Areas alone. While correction of the Problem Areas will result in a marked improvement in water quality, especially in the affected nearshore areas, it will not ensure the elimination of pollution of the Great Lakes.

Eutrophication, one of the major water quality problems identified in the Commission's 1970 Report on pollution in the lower Great Lakes, has affected each of the Great Lakes. The overall impact of eutrophication on Lakes Superior and Huron has been minor, but Lakes Michigan, Erie and Ontario, and such areas as Green Bay and Saginaw Bay, have been significantly affected.

While eutrophication is a natural aging process in water bodies, the addition of large quantities of nutrients (especially phosphorus) to the Lakes and their tributaries have greatly speeded up the eutrophication process, from a geological to a human time-scale. Phosphorus has been identified as the principal controllable nuturient factor responsible for the excessive growth of algae, the most obvious symptom of eutrophication. Problems associated with eutrophication, as it affects man's use of the Great Lakes, include the depletion of dissolved oxygen in the hypolimnion required to support aquatic life (including desirable game fish species), increased water treatment costs, and the loss of recreational opportunities.

There are major inputs to the Great Lakes from both municipal point sources and non-point sources (Table 1). Significant point source discharges above the 1.0 mg/L phosphorus effluent guideline of the 1972 Agreement still exist in the Basin, especially in the lower Great Lakes. The Water Quality Board reported that the aggregate phosphorus concentration (total load divided by total flow) for plants discharging in excess of one million gallons per day was reduced from 2.3 mg/L in 1977 to 1.8 mg/L in 1978. The same level in the Basin in 1975 was 2.6 mg/L. According to data provided in the Commission's report, Pollution in the Great Lakes Basin From Land Use Activities, the largest sources of non-point phosphorus to the Great Lakes are the highly cultivated agricultural lands in northwestern Ohio, southwestern Ontario and southern Wisconsin.

A decrease in phosphorus concentrations in southern Lake Michigan, reported by the Water Quality Board, was believed to be the result of phosphorus control programs in Michigan and Wisconsin.

Municipal phosphorus loads to Lake Superior have remained essentially unchanged since 1975, while Lake Huron loads have increased. The degree of eutrophication in both lakes has remained relatively unchanged from 1977 to 1978.

Despite the reductions in phosphorus loads to the Lower Lakes since 1972, the 1978 loads still were substantially above the 1978 Agreement target loads, as well as those contained in the 1972 Agreement for Lakes Erie and Ontario. Evidence was provided by the Water Quality Board that phosphorus concentrations in Lake Ontario are declining. Perliminary results from the first segment of a two-year intensive surveillance effort begun in 1978 on Lake Erie, however, indicated little change in phosphorus concentrations since

1970. Since trophic status is related to total phosphorus concentration, this suggests that the trophic status of Lake Erie remained relatively unchanged during the 1970's. Phosphorus concentrations in both Lakes Erie and Ontario in 1978 were still above levels believed to cause eutrophication problems.

TABLE 1. ESTIMATED 1978 PHOSPHORUS LOADS TO THE GREAT LAKES (metric tons/year)

Source	Lake				
Direct Industrial	Superior	Michigan	Huron	Erie	Ontario
U.S.	5	46	0	161	55
Canada	68	-	1	30	62
Total	73	46	1	191	117
Direct Municipal					
U.S.	26	494	37	4,381	1,095
Canada	97	-	132	59	817
Total	123	494	169	4,440	1,912
Tributary*					
U.S.	1,362	4,015	1,046	10,880	1,484
Canada	912	-	1,261	1,993	1,415
Total	2,273	4,015	2,307	12,873	2,899
Atmospheric	3,521	1,690	2,120	879	764
Connecting Channels	-	-	657	1,080	5,250
Total	5,990	6,245	5,254	19,463	10,942

*includes monitored and unmonitored tributaries

-dash indicates no input from this source

<u>Toxic and hazardous substances</u> have been the subject of increasing concern and attention since the signing of the 1972 Agreement. Data for many of the "traditional" toxic substances show that these substances are generally declining in the ecosystem in response to control programs. For example, in a number of areas and fish species, mercury and DDT levels in Great Lakes fish have dropped to within public health guidelines. The level of mercury in most small fish in Lake St. Clair, has declined to the point where they are now suitable for unrestricted human consumption. DDT levels in eastern Lake Michigan bloater chubs have been below the Agreement objectives for whole fish since 1976.

On the other hand, a number of other substances (often with unknown effects) have been identified or detected only recently in the Great Lakes Basin ecosystem. Trace levels of dioxin, for example, were identified in 1978 in fish taken from Lake Ontario and Saginaw Bay. PCTs (polychlorinated terphenyls) have now been identified in Lake Erie herring gulls eggs*, despite the fact that these compounds have not been manufactured in the United States since 1971. PCB levels in fish continue to exceed Agreement objectives in many areas throughout the Basin.

The implementation of new and more sophisticated analytical techniques has led to the discovery of toxic and hazardous substances previously undetected in the Great Lakes Basin ecosystem. Other contaminants, as yet undetected, will undoubtedly be identified in the ecosystem with continuing refinement of methods for their detection. The list of chemical substances identified to date in the Great Lakes by the Water Quality Board exceeds 450 in number. Some of these compounds are known to constitute serious environmental or human health problems, and therefore require strict control. Not all of the 450 substances will necessarily constitute such problems, but their presence and the lack of information on their effects signify the need for increased vigilance in the

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*See pp. 17-18 for a discussion of the use of herring gulls as an environment indicator.

careful management of potentially toxic and hazardous substances and in monitoring the Great Lakes environment for their presence and effects .

The problem of toxic and hazardous substances in the Great Lakes Basin ecosystem is serious and widespread, and can have long-term effects. The Commission concurs with its Science Advisory Board, therefore, in strongly urging continued high priority for research and legislative/regulatory action regarding the dispersal and control of man-made chemicals in the environment.

Fish populations are generally demonstrating an improved status over that which prevailed a decade ago. The extent to which the recovery and re-establishment of these fisheries exhibiting this trend is due to pollution control efforts or to fish re-stocking programs and improvement of tributary fish habitats is, however, not clear. A number of major fishery related problems remain to be overcome before the optimal potential of the Lakes as fish producers can be realized. Fish habitat, carrying capacity and productivity continue to be impaired by the effects of cumulative impacts by man on the environment. Contamination of Great Lakes water and biota by toxic and hazardous substances has the potential to undermine many if not all of the fishery improvements attained to date.

Environment Canada's Wildlife Service, with the cooperation of the U.S. Fish and Wildlife Service for Lake Michigan, has used the reproductive success of herring gulls and residues in herring gulls and their eggs in the Great Lakes Basin as measures of the response of the gulls to environmental changes and hence as early warning indicators or "barometers" of the presence of hazardous substances in the ecosystem of which they are a part. The use of these indicators is based on the proposition that herring gulls are at the top of a food chain, and can bioaccumulate persistent organic substances.

The low reproductive success in Lake Ontario herring gulls in 1975 was believed due to elevated levels of persistent organochlorine compounds. By 1978, herring gulls in Lakes Superior, Huron, Erie and Ontario were experiencing normal reproductive success. This coincided with declines in levels of PCBs mirex, DDT, DDE and dieldrin in herring gull eggs taken from these lakes.

The Commission notes that the use of herring gull eggs and reproduction as indicators of levels of toxic substances in the Great Lakes requires caution in interpretation of the results, due to the difficulty in demonstrating a direct connection between the residue levels in the gulls and the water quality in the lakes beside which they are found. An example of this problem is the presence of mirex in herring gull eggs taken from the shores of Lake Superior whereas it was not detected in fish taken from Lake Superior. Thus, migratory behavior or alternate food sources must also be considered when using herring gulls as indicators of Great Lakes water quality.

Despite these concerns about their direct relationship to water quality, the Commission concludes that herring gulls are useful indicators for assessing the presence in the Great Lakes ecosystem of persistent organic compounds of environmental or human health concern. While it can be difficult to determine their precise origin, the detection of such substances in Great Lakes herring gull colonies indicates that these substances have entered and are present in the Great Lakes Basin ecosystem, and hence should be of concern. Conversely, the decline of such substances in gull eggs, and improved reproduction, are encouraging signs that these compounds are declining in other parts of the ecosystem.

The Commission further concludes that use of additional biological indicators having a clearer or more direct relationship to water quality, fish or other specific environmental components of concern, should also be investigated by the Governments.

(ii) Lake Superior

Data from surveys conducted during the Upper Lakes Reference studies in 1974, and from 1978 contaminant and Problem Area surveillance studies in accordance with the Great Lakes International Surveillance Plan indicate that overall water quality in Lake Superior is excellent. Localized pollution exist, however, and there are sources of pollution which should be controlled if this existing high quality is to be maintained.

The levels of most measured toxic contaminants in Lake Superior appear to be declining. PCBs, DDE, DDT, dieldrin and HCB residues in fish have been declining since 1974, suggesting a positive environmental response to the bans of these contaminants.

Some contaminants in several local areas are, however, still above the 1978 Agreement objectives. Mercury levels exceed the 1978 Agreement objective of 0.5 ug/g in whitefish, lake trout and suckers at a number of locations along the Ontario shoreline. PCB concentrations in the same fish from these areas were above the 0.1 ug/g Agreement objective for whole fish, with some of the larger fish (45 cm) having levels above the 2.0 ug/g Canadian Health and Welfare guideline.

Phosphorus levels are generally not a lake-wide problem in Lake Superior. Most of the Lake Superior phosphorus load is from atmospheric and tributary sources. The major non-point contribution is from the forested area occupying a large portion of the basin. Local elevated levels of phosphorus in waters around Thunder Bay and Duluth-Superior harbours were expected to be ameliorated by the new treatment facilities completed during 1978.

(iii) Lake Michigan

Recently completed intensive surveillance activities on Lake Michigan indicate declining concentrations of some contaminants, and high or increasing concentrations of others.

The results of PCB analyses by the Michigan Department of Natural Resources on salmon taken from the little Manistee, Platte, and Grand Rivers indicate that residue levels in eastern Lake Michigan have decreased by as much as 50 percent between 1975 and 1978, although they still ranged between 0.24 and 5.04 ug/g in 1978. The 1978 Agreement objective is 0.1 ug/g in fillets. Similar PCB declines were also reported in bloater chubs in eastern Lake Michigan, although these levels are also still well above the 1978 Agreement objective.

Preliminary data provided by the State of Wisconsin, however, suggests that no similar decline in PCB levels occurred in western Lake Michigan. The reason for the difference between the Michigan and Wisconsin findings for Lake Michigan is a matter warranting further investigation.

Residue levels of DDT in bloater chubs have declined by 90 percent since 1969 and have been below the 1978 Agreement objective of 1.0 ug/g since 1976. Dieldrin levels in bloater chubs, however, have increased from 0.27 ug/g in 1969 to 0.55 ug/g in 1978, almost double the 1978 Agreement objective of 0.3 ug/g. Dieldrin levels in other species, such as coho salmon, are declining and are now below 0.3 ug/g.

Eutrophication studies conducted in 1976-77, when compared with those of the early 1970's and the previous decade indicate that there have been some increases in total phosphorus concentrations. On the other hand, the data also indicate a notable decrease in phosphorus concentrations near the Illinois and Indiana shorelines. This improvement has been linked by the Water Quality Board to remedial programs, including the diversion out of the Basin since 1973 of the discharges from twelve municipal plants and one industry in Lake County, Illinois, Indiana's phosphate detergent ban since 1972, and pollution abatement programs undertaken in northwest Indiana. Increased sedimentation, because of the freezing over Lake Michigan during the winter of 1976-77, has been suggested as another possible factor in this decline in the southern basin. Additional data will help to more clearly demonstrate a cause-effect relationship between remedial programs and water quality in the lake. Lake Michigan is still generally in an oligotrophic state.

(iv) Lake Huron

Assessment of contaminant levels in Lake Huron fish indicate that, although the levels of some contaminants may be decreasing, other contaminants are still of concern. Concentrations of PCBs in a number of large fish species not only exceeded the 1978 Agreement objective of 0.1 ug/g in whole fish, but were also above the Canadian health protection guideline of 2.0 ug/g (edible portion). Mercury levels in large walleye were above the 0.5 ug/g Agreement objective at Port Severn and Giant's Tomb Island. Levels in other species were in compliance at all locations, based on the available data.

Dioxin has been found in fish in the Saginaw Bay area. Although levels are at the analytical detection limit, the extreme toxicity of this compound indicates that further assessment of these concentrations and their environmental implications should be conducted.

Little change has occurred in the oligotrophic status of main Lake Huron waters. Eutrophication problems are restricted primarily to Saginaw Bay and nearshore areas in the southern part of the lake. Total phosphorus loads to Saginaw Bay from the Saginaw River during 1978 were less than one-half the loads reported in 1974. This reduction has been related by the Water Quality Board to point source control measures and to Michigan's detergent phosphate limitation. At the same time, however, total phosphorus concentration in inner Saginaw Bay has increased since 1974. It is possible that decreases in total phosphorus concentration in Saginaw Bay will be constrained by the release of phosphorus from bottom sediments. Intensive lake-wide surveillance activities are planned for 1980.

Between 1976 and 1977, the total phosphorus loads to Lake Huron decreased from 4,145 metric tons/yr to 3,106 metric tons/yr. The estimated load for 1978, however, was 5,197 metric tons.

In its report, Pollution in the Great Lakes Basin From Land Use Activities, the Commission questioned the adequacy of the tentative phosphorus target loads contained in the 1978 Agreement for achieving the relevant phosphorus control goal for Saginaw Bay. In order to eliminate completely taste and odour problems in Saginaw Bay attributable to the phosphorus-induced growth of algae, the Commission has concluded that the input of phosphorus should not exceed 220 metric tons per year, in contrast to the tentative load in the 1978 Agreement of 440 metric tons.

(v) St. Clair River

The Ontario Ministry of the Environment carried out a biological survey in the summer of 1977 along the St. Clair River to update the findings of a previous study done in 1968, as well as to assess the effectiveness of remedial programs undertaken at industrial and municipal facilities along the Canadian shoreline of the river. Data from this survey showed that water quality had improved in the upper reaches and along the United States shoreline, and that "a significant improvement in benthic fauna community" was observed in the vicinity of industrial discharges along the Canadian shore. Some water quality objectives had not been achieved, however, probably because remedial programs had not been completed. This area therefore remained a Problem Area in 1978.

(vi) Detroit River

Since 1967, water quality at the mouth of the Detroit River has been improving for most parameters of concern. A significant decrease has been noted in total phosphorus and chloride levels. Detroit's municipal sewage treatment plant, however, remains the largest point source of phosphorus to the Great Lakes. Although $350 million has already been spent over the past 10 years to upgrade the plant, which processes about 700 million gallons of sewage daily from Detroit and its suburban communities, a July 1978 deadline for attainment of interim effluent limitations was not met. As a result, in March 1979, the Mayor of Detroit was appointed as administrator of the plant, subject only to the Court for its operation. Detroit is presently under a consent judgement to achieve the required full secondary treatment with phosphorus removal by December 31, 1981.

(vii) Lake Erie

The first segment of an intensive two-year surveillance effort was performed on Lake Erie during 1978. Preliminary analyses of the data indicated that mercury levels in fish taken from Lake St. Clair and Lake Erie have continued to decline since point source control was initiated in the Canadian St. Clair basin in 1970. While most small fish are now suitable for unrestricted human consumption with respect to mercury levels, white bass and yellow pickerel taken from the western basin of Lake Erie still had mercury levels exceeding the 1978 Agreement objective of 0.5 ug/g. Total mercury concentrations in waters along the south shore of the eastern basin also frequently exceeded the 1978 Agreement objective.

Concentrations of measured organic contaminants in fish are, with some exceptions, declining. One exception is PCBs which remained above the 1978 Agreement objective of 0.1 ug/g in coho salmon, smelt and lake trout. Low concentrations of polycholorinated terphenyls (PCTs) have been found in herring gull eggs in the western basin of Lake Erie. The environmental properties of PCTs are similar to those of PCBs.

The 1978 intensive study also indicated that the overall phosphorus concentrations in Lake Erie did not change during 1978. Open lake surveys showed no significant change in phosphorus concentrations or chlorophyll a levels since 1970. Oxygen depletion rates in the central basin also have not changed significantly during this period. This lack of overall change in these indicators of lake trophic condition persisted during the 1970's persisted in spite of substantial decreases in phosphorus inputs to the lake during this same period.

In its Report, Pollution in the Great Lakes Basin from Land Use Activities, the Commission questioned the adequacy of the tentative phosphorus target load contained in the 1978 Agreement for achieving the phosphorus control objectives for Lake Erie. The proposed target load of 11,000 metric tons/yr is predicted to achieve about a 90 percent reduction in the anoxic area in the central basin of the lake in an average year. The Commission suggested that a stricter interpretation of the phosphorus control goal (that is, complete elimination of the anoxic area) would require a substantially lower target load of no more than 9,500 metric tons/yr.

(viii) Niagara River

Both the Upper and Lower Niagara River were defined as Problem Areas by the Water Quality Board due to failure to achieve the Specific Objectives for coliform bacteria and phenols. Although most dischargers met the requirements of their relevent agencies, further remedial programs of various types may be required to adequately address pollution problems in this region.

The Upper Niagara River receives discharges from a number of industries on the United States side of the river. Further, combined sewer overflows from Buffalo, New York will continue to cause problems during rainfall periods.

A number of remedial programs have not been completed in the Lower Niagara River. The Niagara Falls, New York sewage treatment plant did not meet its effluent requirement in 1978. This new facility has experienced operational problems due to industrial wastes and excess flows.

The Commission is aware that there has been considerable public and governmental concern about possible water quality problems in the Niagara area. Insufficient data were available for the Commission to assess adequately the situation in the Niagara River during this reporting period. The Commission notes, however, that studies have recently been completed on water quality in the Niagara River and will be reporting on this matter in a future report.

(ix) Lake Ontario

Inputs of pollutants from upstream lakes contribute to the severity of eutrophication and contamination of Lake Ontario. Trends in contaminant levels more or less parallel those in Lake Erie, although the actual levels of contaminants in Lake Ontario are generally higher than in any of the other Great Lakes.

Analyses of contaminant levels in several species of fish collected in Lake Ontario during 1978 indicated that PCB levels in lake trout, rainbow trout and coho salmon were often above the 1978 Agreement objective of 1.0 ug/g for whole fish . Mean concentrations of mirex in smelt, lake trout, rainbow trout and coho salmon also exceeded the 1978 Agreement objective of 0.1 ug/g in whole fish. Indeed, there has been essentially no change observed in residues of PCBs or mirex in fish since restrictions were put on these compounds.

The Water Quality Board concluded that average Spring phosphorus concentrations in Lake Ontario declined significantly between 1970 to 1978, and that Lake Ontario is gradually moving towards acceptable phosphorus concentrations. A substantial decrease was reported for 1978, although the Board noted that this decrease might be due in part to the settling of particulates during the unusually extensive winter ice cover.

Total phosphorus and chlorophyll *a* levels were reported to have shown large declines in the Bay of Quinte between 1976 and 1978. These declines have been attributed by the Water Quality Board to phosphorus removal programs at municipal wastewater treatment plants discharging to the Bay of Quinte and to a lower level of land runoff in 1978.

(x) St. Lawrence River

Low levels of two persistent organic contaminants, hexachlorocyclohexane and lindane, were detected in water samples collected over the entire stretch of the river in the summer of 1977. Further, PCBs were detected in water samples collected at the mouth of the Grass River in concentrations ranging from 0.06 ug/L to 0.18 ug/L. These concentrations were at significantly elevated levels relative to background levels and identify the Grass River as a source of PCB contamination. This problem warrants further investigation to identify the specific sources of the PCBs. Similarly, while most metal concentrations in the St. Lawrence River were well within the 1978 Agreement objectives, concentrations of aluminum, iron and zinc were found at levels higher than background levels at the mouths of the Grass, Raquette and St. Regis Rivers.

Total phosphorus concentration in the St. Lawrence River was 20 ug/L, slightly higher than the mean value measured in eastern Lake Ontario. Concentrations were consistently higher downstream from Brockville and at the mouth of the Grass and St. Regis Rivers. A comparison of data collected between 1973 and 1977 indicates no significant changes in mean surface water total phosphorus concentrations in the river during that period.

3. PROBLEMS AND REMEDIAL PROGRAMS

(i) Industrial and Municipal Programs

The 1978 Great Lakes Water Quality Agreement requires that the Governments continue to develop and implement programs and other measures to fulfill the Purpose of the Agreement and to meet the General and Specific Objectives contained therein, thus continuing the approach taken under the 1972 Agreement. The 1978 Agreement calls for programs for the abatement, control and prevention of pollution from municipal dischargers and from industrial sources entering the Great Lakes System. Thus, the goals of pollution control with respect to the Agreement are the same for both countries.

In taking this approach, the two Governments also recognized that these objectives might well be obtained through policies and programs that are based on differing legislative bases, approaches to pollution control and resource management strategies in the two countries. While pollution control programs may not be identical in both countries, they must be consistent with achievement of the goals of the Great Lakes Water Quality Agreement.

A primary role of the Commission under the Water Quality Agreement is to advise the Governments concerning the effectiveness of programs and other measures taken pursuant to the requirements of the Agreement. An essential part of the information required to carry out this role is an inventory of all point source dischargers in the Basin, including substances discharged and their quantitites, together with an inventory of pollution abatement requirements for all municipal and industrial dischargers, as called for in the 1978 Agreement.

In terms of reviewing achievements under the GLWQA, it is also important that the relationship between domestic control programs and the objectives of the Agreement can be assessed. The pollution control agencies in both countries have various stated policies concerning the use of the Specific Objectives of the

Agreement as a basis for water quality standards or control requirements. The Province of Ontario has stated that the revised Specific water quality Objectives contained in the 1978 Agreement shall be used in this manner and shall be incorporated in Certificates of Approval and Control Orders or other programs. All the States in the Great Lakes Basin have been undertaking revisions to their water quality standards, the current revisions being based on criteria issued by the U.S. EPA, on Agreement objectives and on local considerations. Nevertheless, the Commission also urges the Parties to the Agreement to ensure that all jurisdictions in the Great Lakes Basin take into consideration the General and Specific Objectives in the granting of discharge permits or similar approvals. The Commission has asked the Governments for information on the mechanisms by which this will be carried out, including the consideration of cumulative effects on ecosystem quality of permits within and between jurisdictions.

The Commission has at present two principal sources of information by which it can address the status of pollution control programs in the Basin. These are the Problem Area analysis of the Water Quality Board and the inventory of major municipal and industrial point source dischargers in the Great Lakes Basin.

As noted earlier, there remain a number of Problem Areas in the Basin where water quality objectives are exceeded (Figure 1). There are 14 such areas within Canadian jurisdiction, 28 areas within United States jurisdiction and six areas shared between the two countries.

Despite the industrial pollution control efforts that have taken place to date and the improvement in treatment of municipal wastes in the Basin, an overall review of these areas shows, as noted earlier, that little change has occurred in their status since the 1972 Agreement was put into effect. Most individual dischargers are now subject to control programs. A number of reported industrial and municipal dischargers to the Problem Areas were not meeting domestic requirements, however, or were operating under remedial programs that were either inadequate to meet the Specific

Objectives or would meet the objectives only over the long term. A list of all major Problem Area dischargers and the status of their remedial programs is contained in Appendix II.

The Inventory of Major Municipal and Industrial Point Source Dischargers in the Great Lakes Basin provides a listing of major dischargers to the Great Lakes System, quantities discharged and domestic compliance requirements. It should be emphasized, however, that the information contained in the point source inventory is incomplete, consisting of only about 900 of the dischargers in the Basin. The criteria established by the various jurisdictions for defining a "major discharger" are not clear and may well vary between jurisdictions. There is little uniformity in the parameters reported with regard to compliance with pollution control requirements. Also, the data in the inventory do not indicate whether domestic compliance requirements were in themselves adequate to meet the terms of the Great Lakes Water Quality Agreement or the water quality impacts of failure to meet compliance requirements. Simply comparing the number of dischargers in compliance with jurisdictional requirements is not a sufficient basis for assessment. The Commission recommends that Governments provide a complete inventory of point source dischargers incorporating information that will address the above concerns in the preparation of the inventory of pollution abatement requirements for all municipal and industrial dischargers, which is called for in Article VI of the 1978 Agreement.

Notwithstanding these limitations concerning the point source inventory, the Commission believes some valid indications can be drawn as to the status of pollution control programs in the two countries. Based on data from the inventory, Table 2 provides a summary of the compliance status of municipal and industrial point source dischargers. The data shows that with respect to municipal dischargers in the Basin, 122 Canadian sewage treatment plants and

TABLE 2. COMPLIANCE STATUS OF REPORTED POINT SOURCE DISCHARGERS IN THE GREAT LAKES BASIN

	Number of Plants in Compliance		Number of Plants not in Compliance		Percent of Reported Plants in Compliance	
I. Municipal Plants						
Lake Superior	1977	1978	1977	1978	1977	1978
U.S.	2	11	9	4	18	73
Canada	3	4	3	1	50	80
Lake Michigan						
U.S.	34	53	38	27	47	66
Canada	-	-	-	-	-	-
Lake Huron						
U.S.	8	9	5	8	62	53
Canada	19	24	6	7	76	77
Lake Erie						
U.S.	23	55	65	45	26	55
Canada	30	37	2	1	94	97
Lake Ontario						
U.S.	34	39	29	13	54	75
Canada	48	46	18	5	73	90
Int'l Section of St. Lawrence River						
U.S.	-	5	-	0	-	100
Canada	-	11	-	1	-	92
Total Great Lakes Basin						
U.S.	100	172	146	97	41	64
Canada	101	122	29	15	78	89

TABLE 2. COMPLIANCE STATUS OF REPORTED POINT SOURCE DISCHARGERS IN THE GREAT LAKES BASIN (cont'd)

	Number of Plants in Compliance		Number of Plants not in Compliance		Percent of Reported Plants in Compliance	
II. Industrial Plants						
Lake Superior	1977	1978	1977	1978	1977	1978
U.S.	10	14	7	3	59	82
Canada	3	6	7	4	30	60
Lake Michigan						
U.S.	72	84	35	22	67	79
Canada	-	-	-	-	-	-
Lake Huron						
U.S.	17	19	6	3	74	86
Canada	7	3	4	8	64	27
Lake Erie						
U.S.	39	55	45	38	46	59
Canada	13	19	11	6	54	76
Lake Ontario						
U.S.	72	92	57	19	56	83
Canada	15	18	28	24	35	43
Int'l Section of St. Lawrence River						
U.S.	-	11	-	2	-	85
Canada	-	3	-	5	-	38
Total Great Lakes Basin						
U.S.	209	275	151	87	58	76
Canada	38	49	50	47	43	51

172 U.S. plants met domestic requirements, while 15 Canadian and 97 U.S. plants did not. The number of municipal plants complying increased markedly in both countries between 1977 and 1978, due primarily to the completion of a large number of on-going remedial projects.

With respect to industrial dischargers, 47 Canadian and 87 U.S. plants were not in compliance with domestic requirements. The degree of compliance in the U.S. in 1978 was a substantial increase over the previous year, due in large part to the completion of a number of NPDES industrial compliance programs after their July 1, 1977 statutory deadline. The number of plants in compliance in Canada in 1978 showed little improvement over the previous year. In summary, Table 2 shows that almost half the 96 Canadian industrial dischargers in the inventory were not meeting their domestic requirements in 1978, while one quarter of the 362 U.S. industrial dischargers were not doing so.

Overall, on the basis of the information in Table 2 and Appendix II, it would appear that progress in industrial abatement programs was more substantial in 1978 in the United States than in Canada, whereas progress with respect to completion of municipal programs has been more substantial in Canada. It can also be concluded that the implementation of pollution control programs in both countries is proceeding at a slower rate than is desirable from a strictly environmental viewpoint. Delays in implementation are believed to have been in many cases the result of financial constraints, the judicial review process or other governmental priorities, rather than to the lack of technology.

The importance of economic considerations in the setting of standards and/or industrial requirements in both Canada and the United States is discussed in the 1978 Annual Report of the Water Quality Board. Under both systems, socio-economic factors are taken into account at some point in the regulatory process, whether in the setting of standards and dates by which they are to be achieved, in their application to individual dischargers, or in the judicial or administrative assessment of penalties for failing to implement requirements.

In previous reports, the Commission directed its attention to the question of the effectiveness of the U.S. and Canadian domestic programs concerning industrial pollution control. In its Fifth Annual Report, the Commission expressed concern about the apparently uneven approach to industrial pollution control, whereby both the setting of the regulations and their enforcement appeared to be more flexible in Canada than in the U.S. and suggested the need for an analysis of the relative effectiveness of the two systems. In the Sixth Annual Report, the Commission concluded from detailed studies by its Great Lakes Water Quality Board that essentially equivalent results had been achieved in the refining industry, marginally better U.S. results in the steel industry, and more effective control in the United States in the pulp and paper industry. It was further concluded that these differences reflected differing legislation, economic conditions, public interest, treatment requirements and the condition of the plants themselves. The Commission is pleased to ote in this regard that the Governments of Canada and Ontario have taken action during the past year in response to the problems experienced by Ontario in achieving both adequate pollution control and modernization within this industry. This has been in the form of a new program of grants to the pulp and paper industry to encourage both plant modernization and pollution control expenditures, as well as a number of direct pollution control actions.

With respect to municipal treatment plants, the Commission does have other bases for comparing and assessing pollution control efforts under the Agreement. It is noted, for example, that in 1978 additional commitments were made in both countries for the construction and operation of municipal waste water treatment facilities. All levels of government in Ontario provided $191 million to capital commitments for treatment plants and interceptor sewers, bringing its total committed funds since 1971 to $991 million. The obligated state and federal funds in the United States for municipal sewerage construction amounted to $618 million, for a total commitment of $4.32 billion since 1971. The progress achieved in reducing municipal phosphorus loads from plants discharging in excess of one million gallons per day (1MGD) is shown in Table 3.

Despite the magnitude of committed or obligated funds for municipal sewage projects, a number of major municipal treatment plants are still incomplete. Table 4 summarizes the progress of construction of major municipal projects as of January 1, 1979. Continuing delays have occurred in completion of the construction projects for Detroit, Gary and the three Cleveland plants. The Detroit and Cleveland plants represent a major proportion of the municipal phosphorus loads entering Lake Erie. Facilities at Duluth, Tonawanda, and Thunder Bay were completed and put into operation in 1978.

Programs designed to limit the phosphorus concentrations to 1.0 mg/L in effluent from all municipal wastewater treatment plants discharging a greater than 3800 m^3/d (1MGD) are in effect in both the Canadian and United States portion of the Lake Erie and Lake Ontario basins. Compliance with this effluent limitation is another measure of progress under the Agreement. While not all Canadian plants discharging over one million gallons per day achieved the 1.0 mg/L effluent target in 1978, some surpassed it so that the total loading from Canadian plants to Lake Erie was less than the load expected if all major plants had been discharging effluents with phosphorus concentrations of 1.0 mg/L. The loads to Lake Ontario from Canadian plants was slightly in excess of that expected if all major plants were meeting their 1.0 mg/L phosphorus effluent requirement. The loads from U.S. plants have decreased substantially, but were still more than double the U.S. municipal target loads for both Lake Erie and Lake Ontario. This was due in large part to excessive phosphorus inputs from several large municipal treatment plants in the United States. Table 5, which ranks the largest 20 municipal sewage treatment plants by phosphorus loadings to the Great Lakes, shows that a number of the largest contributors of phosphorus were not meeting the phosphorus effluent limitation in 1978. The list of reported municipal dischargers to the Great Lakes System is presented in Appendix III.

TABLE 3. PHOSPHORUS LOADS FROM MAJOR MUNICIPAL WASTEWATER TREATMENT PLANTS* IN THE GREAT LAKES BASIN

LAKE BASIN	1975	1976	1977	1978	"TARGET**"	EXCESS
			(metric tons/year)			
SUPERIOR						
United States	163	187	115	131	56	75
Canada	57	65	102	91	26	65
Total	220	252	217	222	83	139
HURON						
United States	156	119	174	200	164	36
Canada	172	175	179	201	90	111
Total	328	294	353	401	254	147
MICHIGAN						
United States	2,105	1,390	1,717	1,281	1,140	141
ERIE						
United States	7,731	6,526	6,507	5,614	2,284	3,330
Canada	219	252	250	222	241	---
Total	7,950	6,778	6,757	5,835	2,525	3,330
ONTARIO						
United States	1,825	1,537	2,244	1,568	778	790
Canada	2,475	1,321	1,143	1,071	900	171
Total	4,300	2,858	3,387	2,640	1,679	961
Basin Total	14,903	11,572	12,431	10,379	5,681	4,718

* Plants discharging in excess of 3,800 m^3/d (1 MG/D)

**1972 Agreement Loading Objectives

TABLE 4. STATUS OF CONSTRUCTION OF MAJOR MUNICIPAL PROJECTS IN THE GREAT LAKES BASIN
(As of January 1, 1979)

FACILITY	POPULATION SERVED BY SEWERS	ANTICIPATED COMPLETION DATES As Stated in 1976 WQB Report	ANTICIPATED COMPLETION DATES Current Status	COSTS TO COMPLETE CURRENT PROGRAM (Millions of Dollars)
UNITED STATES				
Detroit, Michigan	3,129,000	After 1980	Dec. 31, 1981	482
Duluth, Minnesota				
Western Lake Superior				
Sanitary District	126,000	Nov. 1978	Operational	-
Gary, Indiana	175,000	1977	1982	76
Cleveland, Ohio				
Westerly	250,000	1981	1982	90
Easterly	700,000	1978	1982	45
Southerly	635,000	1981	1982	290
Tonawanda, New York				
Sanitary District #2	107,700	1978	Operational	-
Syracuse Metro,				
New York	287,600	June 1979	June 1979	108
Buffalo, New York	750,000	1979	1979	170
CANADA				
Thunder Bay	106,000	July 1977	Operational	-

TABLE 5. RANKING OF THE TOP 20 MUNICIPAL PHOSPHORUS DISCHARGERS TO THE GREAT LAKES SYSTEM

Rank*	Facility	Juris-diction	Basin	1978 P-Load kg/d	(lb/d)	1978 P-Conc (mg/L)
1	Detroit STP	MI	Erie	7179	(15827)	2 91
2	Buffalo S A STP	NY	Ontario	1771	(3904)	2 51
3	Euclid STP	OH	Erie	1573	(3468)	13 92
4	Cleveland Southerly STP	OH	Erie	1203	(2652)	3 19
5	Toledo STP	OH	Erie	747	(1647)	2 36
6	Syracuse Metro STP	NY	Ontario	612	(1351)	2 77
7	Toronto Main STP	ON	Ontario	567	(1250)	0 74**
8	Hamilton STP	ON	Ontario	498	(1098)	2 10
9	Grand Rapids STP	MI	Michigan	466	(1027)	2 60
10	Erie STP	PA	Erie	433	(955)	2 22
11	Cleveland Westerly STP	OH	Erie	400	(882)	3 60
12	Milw Sewer Comm South Shore	WI	Michigan	380	(838)	1 23
13	Akron STP	OH	Erie	380	(838)	1 21
14	Toronto Humber STP	OH	Ontario	377	(831)	1 00**
15	Lorain STP	OH	Erie	370	(816)	6 17
16	Rochester STP (Frank Van Lare)	NY	Ontario	336	(741)	1 07
17	Wayne Co DPU STP	MI	Erie	299	(659)	1 00**
18	Kalamazoo STP	MI	Michigan	292	(644)	2 43
19	Cleveland Easterly STP	OH	Erie	289	(637)	0 60**
20	Wyoming STP	MI	Michigan	278	(613)	5 63

*Rank based on 1978 phosphorus load to lake

**Plants in compliance with the 1.0 mg/L effluent limitation

As of December 31, 1978, 64 percent of the population of 15.3 million served by sewers in the United States portion of the Great Lakes Basin was provided with adequate treatment, representing an increase of 70,000 people over the 1977 level. The population served by sewers is about 80 percent of the total population in the United States. Adequate treatment is defined by United States jurisdictions as a minimum of secondary treatment, with effluent concentrations of 30 mg/L for BOD and suspended solids and 1.0 mg/L for total phosphorus. If water quality standards are not met by secondary treatment, then advanced waste treatment is required. Completion of facilities under construction are expected to provide 99 percent of the United States population served by sewers in the Basin with adequate treatment by 1983.

In Ontario, 99 percent of the population served by sewers in the Canadian portion of the Basin was served by adequate treatment in 1978. Adequate treatment is defined in Ontario as a minimum of secondary treatment with phosphorus removal, with 20 mg/L BOD and suspended solids in the treated effluent. Upgrading of wastewater treatment facilities and emphasis on plant operations account for recent improvements.

Although the progress made in treating municipal waste waters in the Basin has been encouraging, the Commission concurs with its Water Quality Board that a higher rate of Basin-wide compliance with the 1.0 mg/L phosphorus effluent guideline could be achieved if operating and maintenance procedures were followed so as to ensure that plant performance was in accordance with the design efficiency of the plant, and if the skills of the operators were continually upgraded. The performance of many plants can be enhanced with improved operation and maintenance practices.

A number of solutions to operational problems at municipal wastewater treatment plants was identified at a 1978 workshop held by key United States and Canadian regulatory agencies. One recommendation stemming from the workshop was for federally-funded (on a one-time basis) operation and maintenance improvement grants to establish comprehensive correction programs including the preparation of an operation and maintenance manual, cost accounting procedures, preventive maintenance plans, staffing recommendations and training. Mandatory plant operator certification, review of facility design, more reliable equipment, and better operation and maintenance of existing technology were also emphasized.

Both EPA and the Ontario Ministry of the Environment have taken steps to improve the operation and maintenance of municipal wastewater treatment plants in accordance with some of the solutions proposed at the workshops. EPA has accelerated its enforcement activities against major municipal treatment facilities not in compliance with discharge permits and has changed the emphasis of its Operations and Maintenance Research Program at the Municipal Environmental Research Laboratory to address design and operational deficiencies of existing technology related to O&M problems. It is also considering making an independent review of facility designs for operational, maintenance and reliability consideration mandatory for construction and grant funding.

In the Province of Ontario, high priority is currently being given to the information exchange between plants and the Province, and to development of uniform sampling and monitoring programs, in order to assure appropriate performance evaluations. The Ontario Ministry of the Environment, which has been directly responsible for the Operation and Maintenance of many Ontario municipal wastewater treatment plants, has been transferring this responsibility, as well as responsibility for new facility development, back to the municipalities. The Commission urges the Government of Ontario to ensure that this transfer does not negatively affect the development, operation and maintenance of the plants in question.

Phosphorus management strategies, including the cost-effectiveness and technical capability of attaining more stringent controls at wastewater treatment plants, have been under review. The Commission has referred this matter among others to its Task Force on Phosphorus Management Strategies and will advise the Governments further on the adequacy of current phosphorus load estimates, loading objectives, and the costs and effectiveness of various phosphorus remedial measures when its review of the Task Force study is completed.

Pending its report further to the Task Force studies, the Commission repeats the recommendation it made in its report, <u>Pollution in the Great Lakes Basin from Land Use Activities</u>, that Governments should exercise caution when approving sewage projects in order to ensure that such projects would not inhibit later upgrading of facilities and/or programs to accommodate any new phosphorus strategies that may be appropriate following the Commission's further report on this matter.

(ii) Toxic and Hazardous Substances

As stated earlier in this Report, the problem of toxic and hazardous substances becomes more complex as more wastes are being produced and as more information becomes available on their presence in the ecosystem and on the potential effects of these substances. A vast number of chemical compounds are manufactured or sold in the Great Lakes Basin, and many are entering the Great Lakes Basin ecosystem. These compounds are very numerous, ubiquitous in their use, often complex in their chemistry, and unknown as to ultimate impacts on man and the environment. Indeed, man-made chemicals of various kinds are found in virtually all components of the Great Lakes Basin ecosystem.

At present, there is no agreement among agencies, either between or in some cases within jurisdictions, concerning the appropriate basis and methodology for a coordinated hazard assessment program for chemicals in the Great Lakes Basin. Numerous techniques for hazard assessment currently exist and there is no assurance that toxic and hazardous substances will be identified and controlled with a common approach under the Great Lakes Water Quality Agreement. The Commission recommends the resolution of this problem as a basis for coordinated management of toxic and hazardous substances in the Great Lakes ecosystem, and in fulfilling the commitment of the Great Lakes Water Quality Agreement. Development of such a common procedure should not, however, interfere with on-going or planned control programs for toxic and hazardous substances.

The Water Quality Board planned to sponsor a series of workshops as part of its review of the problem and programs to control the discharge of toxic and hazardous substances in the Basin. The first workshop, held in Ann Arbor, Michigan in April 1979, was to review the hazard assessment procedures used by agencies in the Basin. A major problem encountered at this workshop was the lack of a common understanding on hazard assessment. This resulted in subsequent workshops being postponed until this initial basic concern is resolved. As a result of the first workshop, however, the Board recommended a small work group be formed for this purpose. This work has since been undertaken as part of the activities of the Board's new Toxics Committee, which was established under its recent reorganization.

The Commission is concerned about the serious problem of the shortage of adequate laboratory facilities and trained personnel for analyzing toxic and hazardous substances in the Great Lakes Basin ecosystem. Analytical procedures to identify and measure very small concentrations of such chemicals require expensive, specialized equipment and highly trained personnel. Insufficient analytical resources in the Great Lakes Basin handicaps identification and measurement of hazardous and toxic substances, and their impacts on humans and other components of the ecosystem. Therefore, the Commission urges the Governments to ensure that sufficient analytical resources are available to meet requirements of a comprehensive program for the control of toxic and hazardous substances.

In its July 1978 Report to the Commission, the Research Advisory Board (now the Science Advisory Board) described its development of a computer data bank designed to identify chemicals manufactured or used in the Great Lakes Basin which have the potential to persist or bioaccumulate in the ecosystem, and which are therefore of particular concern in the Basin. In January 1979, this data base, the Information System for Hazardous Organics in a Water Environment (ISHOW), became operational at the EPA Environmental Research Laboratory in Duluth, Minnesota. As of the end of 1978 ISHOW, consisting primarily of United States data, had an inventory of nearly 3,000 separate chemical compounds. Based on past surveillance efforts and other studies, residues of about 450 of these compounds have been identified so far by the Water Quality Board in various components of the Great Lakes Basin ecosystem.

The Commission again draws the attention of the Government of Canada to the concern expressed in its Sixth Annual Report regarding the difficulty in obtaining the necessary data on chemical compounds used, manufactured or imported for use in Canada. The provision of such data is required to ensure that the data base for toxic and hazardous substances is sufficiently comprehensive to permit the identification and assessment of those chemicals that may be of concern in the Great Lakes Basin ecosystem. As one specific measure, the Commission recommends that the ISHOW data base be provided with the necessary information on chemicals in both the United States and Canadian portions of the Great Lakes Basin.

With respect to Annexes 10 and 12 of the 1978 Agreement, which address "Hazardous Polluting Substances" and "Persistent Toxic Substances", respectively, the Commission endorses the approach (Appendix I) recommended by its Science Advisory Board concerning a procedure regarding the implementation of these Annexes.

Activities of the WQB/SAB Committee on the Assessment of Human Health Effects involve assessment of the risk to human health of the above 450 identified substances. This effort involves gathering and reviewing information for each contaminant on the basis of the following six categories: acute toxicity, carcinogenecity, chronic adverse effects, heritable mutagenecity, neurobehavioural toxicity and reproduction. The initial focus of the Committee is on lead and mirex.

The Great Lakes Science Advisory Board and the Water Quality Board are placing increased emphasis on toxic and hazardous substances in the environment and their effects on the Great Lakes Basin ecosystem. In the meantime, due to the immediate importance of this problem to the Great Lakes Basin ecosystem, the Commission urges the Governments to accelerate their efforts to control toxic and hazardous substances in the Basin.

(iii) Hazardous Waste Management

Both public and governmental awareness of the real and potential problems associated with hazardous industrial wastes, their disposal and their environmental and health impacts, has been raised in recent months, especially since the Love Canal incident in Niagara Falls, New York. It is now evident that thousands of sites containing hazardous wastes exist across the landscape of North America. Large quantities of toxic and hazardous materials in unsafe sites must be safely contained. Further, additional quantities of such substances are being produced daily and will continue to be produced until such time as environmentally-safe substitutes can be developed, or unless industrial economic activity is to be disrupted by prohibiting the use of such chemicals.

The Commission recommends that the replacement of toxic substances in the manufacturing process with less hazardous materials, methods for their destruction after use, and the reduction of wastes through product modification, recycling or closed-loop production systems, all be vigorously pursued by industry and by Governments. As this may not be achieved in the near future, the Commission also recommends that Governments ensure that comprehensive systems of hazardous waste management be developed to ensure the safe storage, transportation and disposal of hazardous wastes.

Several areas requiring immediate attention in the development of a successful hazardous waste control program were identified in the 1978 Annual Report of the Water Quality Board. A multitude of industrial chemical wastes continue to be generated and disposed of in large quantities by uncontrolled and unsafe methods. There is at present no effective Basin-wide operating plan to cope with the generation, transportation and disposal of hazardous wastes in the Great Lakes Basin. The Commission concurs with its Board's conclusion that the existence of uncontrolled accumulations of hazardous wastes, whether they exist in improperly-constructed disposal sites or inadequate temporary storage facilities, is an extremely serious environmental and health risk in the Basin.

Since the Love Canal incident, public resistance to the establishment of new waste disposal sites has become widespread. As a result, no new disposal sites were established in the Great Lakes Basin in 1978. In both Ontario and the United States, proposals to establish new disposal facilities have met with considerable public resistance. Concern regarding existing sites is also evident. New York State issued a permit for the expansion of an existing site, but lawsuits were instituted against the State by local citizens opposing this action.

While the public's resistance is understandable, it is also clear that safe disposal sites for hazardous wastes are required, at least in the short-term. It is thus necessary that steps be taken by the Governments to increase public understanding of the problem and to assure the public that safe waste disposal is technically possible and can be provided and maintained. Temporary storage facilities, or the use of constructed solid waste sites not designed for this purpose but which are currently used in some areas, are practices posing potentially serious health threats, particularly where drainage from such sites can reach surface and ground water.

The Commission suggests that part of the solution to public reluctance to accept new or expanded disposal sites lies in shifting the economic risk involved from the individuals directly affected to society as a whole. It is suggested that Governments explore means to protect the public from potential losses to real estate values, property or health by providing for compensation to persons residing near proposed disposal sites and transportation routes. Such a procedure may ameliorate the present "no gain" situation faced by residents located in the vicinity of proposed sites or routes. Existing systems for public insurance compensation and liability procedures in other policy areas may provide some guidance as to appropriate mechanisms for implementing this approach. This does not, of course, diminish the basic need to reduce the generation of hazardous wastes, nor the need for safe design, construction and operating standards, extensive testing and monitoring systems for required sites.

In addition to establishing comprehensive waste management systems for dealing with current industrial hazardous wastes, there is a continuing need to identify existing and abandoned hazardous waste disposal sites, and the Commission currently awaits status reports from the Governments on these surveys.

Other important aspects of the hazardous waste management issue include the dangers and safeguards concerning temporary storage and transportation of hazardous wastes. With the paucity of safe disposal sites, wastes must often be hauled over long distances through the Great Lakes Basin. Often the wastes are stock-piled until transportation and disposal areas are available. Safe transportation and storage methods, including inter-jurisdictional manifest systems, equipment design and maintenance standards, contingency plans for emergencies and clear lines of responsibility and availability, all need to be ensured. Governments have taken some steps to deal with these problems, such as the Resource Conservation and Recovery Act in the United States and the Province of Ontario's seven point program on industrial waste management. As of the writing of this report, many new regulations have been promulgated but their effectiveness has yet to be demonstrated.

The Commission has provided an overview of the current status of hazardous waste management, with emphasis on hazardous waste disposal, in its report, Pollution in the Great Lakes Basin from Land Use Activities. A number of recommendations concerning the control of hazardous wastes are provided therein, and the Commission again recommends their early implementation. Further, it was recommended, analagous to the concern expressed to Governments in the report, Water Quality of the Upper Great Lakes, that the manufacture, use or importation of any persistent synthetic organic compounds having known toxic effects and whose use is such that its entry into the environment cannot be prevented, should be prohibited in the Basin.

(iv) Phosphorus Control Strategies

To date, primary emphasis has been placed on phosphorus removal at municipal wastewater treatment plants and on controlling the phosphate content of detergents as methods of controlling phosphorus inputs to the Great Lakes. The efforts to implement programs aimed at limiting municipal effluent phosphorus concentration to 1.0 mg/L mean that a significant aspect of present phosphorus control in the Great Lakes Basin rests in the efficiency of operation and maintenance of wastewater treatment plants in the Basin. The proportion of plants in both countries which are in compliance with their respective pollution control requirements increased from 54 percent in 1977 to 71 percent in 1978. A higher rate of compliance would, however, be expected if municipal dischargers followed more closely the recommended design, operating and maintenance procedures for their plants. If such procedures were vigorously followed, this would aid in assuring that the design efficiency of the facilities was being achieved. Programs are also required to keep current, and upgrade where necessary, the skills of plant operators.

The Commission notes the advances made in reduction of the phosphorus content in detergents, specifically the implementation during 1979 of phosphate limitations in Wisconsin and Michigan. As there is a need to take every reasonable measure to assist in reducing phosphorus loads to the Great Lakes, the Commission is still concerned, however, about the lack of progress made in reducing the phosphorus content of detergents in the States of Pennsylvania and Ohio, especially the latter. Of the ten plants in the Great Lakes Basin that discharge the greatest quantity of phosphorus in excess of the 1.0 mg/L effluent requirement of the Great Lakes Water Quality Agreement, six are in the Lake Erie basin, and five of these six are in the State of Ohio. The Commission continues to believe that phosphorus should be controlled to the extent possible at its source and therefore reaffirms the recommendation in its 1976 report for a Basin-wide detergent phosphate limitation.

Measures and strategies for controlling phosphorus have been addressed to various degrees since the Commission's Sixth Annual Report on Great Lakes Water Quality. The Commission itself reported to the Governments in April 1980 on the significance of non-point (including land-use and atmospheric) sources of phosphorus to the Great Lakes and remedial measures for their control. A further activity of the Commission was the initiation of its joint SAB/WQB Task Force on Phosphorus Management Strategies (TFPMS). The Terms of Reference of the TFPMS included the evaluation of the mathematical models used to derive the 1978 Agreement proposed phosphorus target loads, evaluation of the accuracy of present phosphorus load estimates, phosphorus control technologies and their associated costs, and the technical feasibility and cost/effectiveness of alternative phosphorus control strategies. The interim findings of the Task Force were the basis for the Commision's tentative conclusion in its report, Pollution from Land Use Activities in the Great Lakes, that the proposed target loads outlined in the 1978 Great Lakes Water Quality Agreement are valid goals on which to formulate phosphorus reduction programs within the life of the 1978 Agreement. As noted elsewhere in this report, however, the Commission questioned the adequacy of the proposed target loads for achieving the phosphorus control goals for Lake Erie and Saginaw Bay. The Task Force reported to the Commission in mid-1980. The Task Force report, together with the views of the Science Advisory and Water Quality Boards, will form part of the basis for a special report to the Governments from the Commission regarding phosphorus management strategies in the Great Lakes Basin.

In conjunction with these activities, the International Joint Commission, through the TFPMS, co-sponsored a week-long conference with Cornell University entitled "Phosphorus Management Strategies for the Great Lakes". This conference addressed possible alternative strategies and related technical topics that should be considered for the effective management of phosphorus in the Great Lakes Basin. Information about the proceedings of this Conference can be obtained from the Commission.

The SAB's Expert Committee on Engineering and Technological Aspects, which played a major role in the initiation of the TFPMS and its study, continued to plan an active role in the review of relevant topics concerning Great Lakes phosphorus control, including the biological availability of phosphorus, a technological and economic assessment of wastewater treatment systems, sludge disposal, and the phosphorus removal efficiency of municipal wastewater treatment plants.

The Great Lakes Water Quality Board undertook a review of the feasibility of the land application of municipal wastewater in the Basin. The Board concluded that land application of municipal wastewaters as a means of reducing phosphorus loads is a viable alternative to conventional and/or advanced wastewater treatment procedures at locations in the Basin where the processes are feasible. Effluent concentrations below 0.1 mg/L phosphorus (well below the 1972 and 1978 Agreement phosphorus effluent limitations) could be achieved consistently with this technique, and the discharge of other materials to surface and ground waters could also be reduced. Experience in the United States has been generally positive, and this technique is being actively promoted by the EPA, including additional subsidization where required. The experience in Ontario, however, has been less successful and less reliance is being placed on this technique due to climatic conditions, land availability, operating costs and technical difficulties, which are believed by the Ministry of the Environment to severely limit the application of this technique. The Board concluded that land application should be considered on a site-specific basis for implementation where it will be cost-effective and environmentally sound. The method is one of the several alternative technologies which the Commission will consider in its report on phosphorus management strategies.

(v) Long Range Transport of Airborne Pollutants

A number of recent studies and reports under the auspices of the International Joint Commission have provided new information concerning the atmospheric transport and contribution of a number of pollutants to the Great Lakes Basin ecosystem. High percentages of the total loads of a number of heavy metals to Lakes Superior and Huron result from atmospheric inputs, according to the Upper Lakes Reference Study. Atmospheric inputs of phosphorus to Lakes Superior, Michigan and Huron have been estimated at 37, 26 and 23 percent of total lake loads, respectively. The comparable figure for Lakes Erie and Ontario is about four percent of the total load. This lower percentage figure is due to the smaller area of these basins and the much greater quantity of phosphorus from other sources.

The transmission of toxic and hazardous substances to the Great Lakes via long range atmospheric transport and deposition is a serious problem which requires further research efforts and control measures. The seriousness of the problem is demonstrated by the distribution of PCBs and lead in the Basin. PCBs are found throughout virtually all components of the Great Lakes Basin ecosystem, even in the remotest areas of Lake Superior. This widespread occurrence of the PCBs is believed to be the result of the long range atmospheric transport of this compound. Similarly, lead is widely found in sediments near urban centers of the Great Lakes, and is believed to be largely due to the atmospheric transport of lead from automobile exhausts.

The actual sources of atmospheric pollutants to the Great Lakes Basin are varied. They include non-point sources, such as open fields and storage piles, the burning of materials containing these substances, and motor vehicle exhausts. As well, major point sources, notably industrial and public utility complexes, are located throughout eastern North America.

Acidic precipitation is one widely known and serious example of a problem associated with the long-range transport of airborne pollutants. Now widely known as acid rain, this phenomenon results primarily from the transformation of sulphur and nitrogen oxide emissions to the atmosphere which, after conversion to acids by chemical processes in the atmosphere, are deposited in the form of precipitation. This deposition is often many hundreds of miles from the sources.

Virtually all of eastern Canada and portions of the northeastern United States experience rains with acidity equal to or exceeding that which can adversely affect susceptible ecosystems. All parts of the Great Lakes watershed are now receiving precipitation containing 5 to 40 times more acid than would occur in the absence of atmospheric emissions. Many inland lake ecosystems in the most susceptible parts of the Basin may be irreversibly harmed within 10-15 years. The map of increased acidity in precipitation (Figure 2), provided by the Science Advisory Board in July 1979, shows the severity and distribution of this problem in the Great Lakes Basin.

The acidity of the open waters of the Great Lakes is not expected to be increased by acid rain because the Great Lakes are large in volume and relatively well buffered (i.e., resistant to changes in pH) due to the geology of much of the drainage area. Localized increased acidity has been detected in some small embayments of Georgian Bay. On the other hand, a substantial portion of the Great Lakes drainage basin is potentially susceptible to acidic precipitation, based on its bedrock geology. The Sudbury, Muskoka and Haliburton areas of Ontario and the Adirondacks of northern New York are among the most heavily impacted areas in the world because their geology offers little buffering capacity to their inland lakes. Some lakes in the Haliburton-Muskoka area have lost 40-75 percent of their acid neutralizing ability in a decade or less. These areas are now being subjected to precipitation which is twice as acidic as that which caused losses of major fish stocks in thousands of Scandinavian lakes.

Other general ecological effects of acid precipitation are believed to include the direct acidification of soil, leading to the long-term destruction of its natural buffering capacity (rain is naturally mildly acidic, but is usually neutralized as it drains through the soil) and fertility (due to the release of vital nutrients in the soil). Further concerns include direct damage to

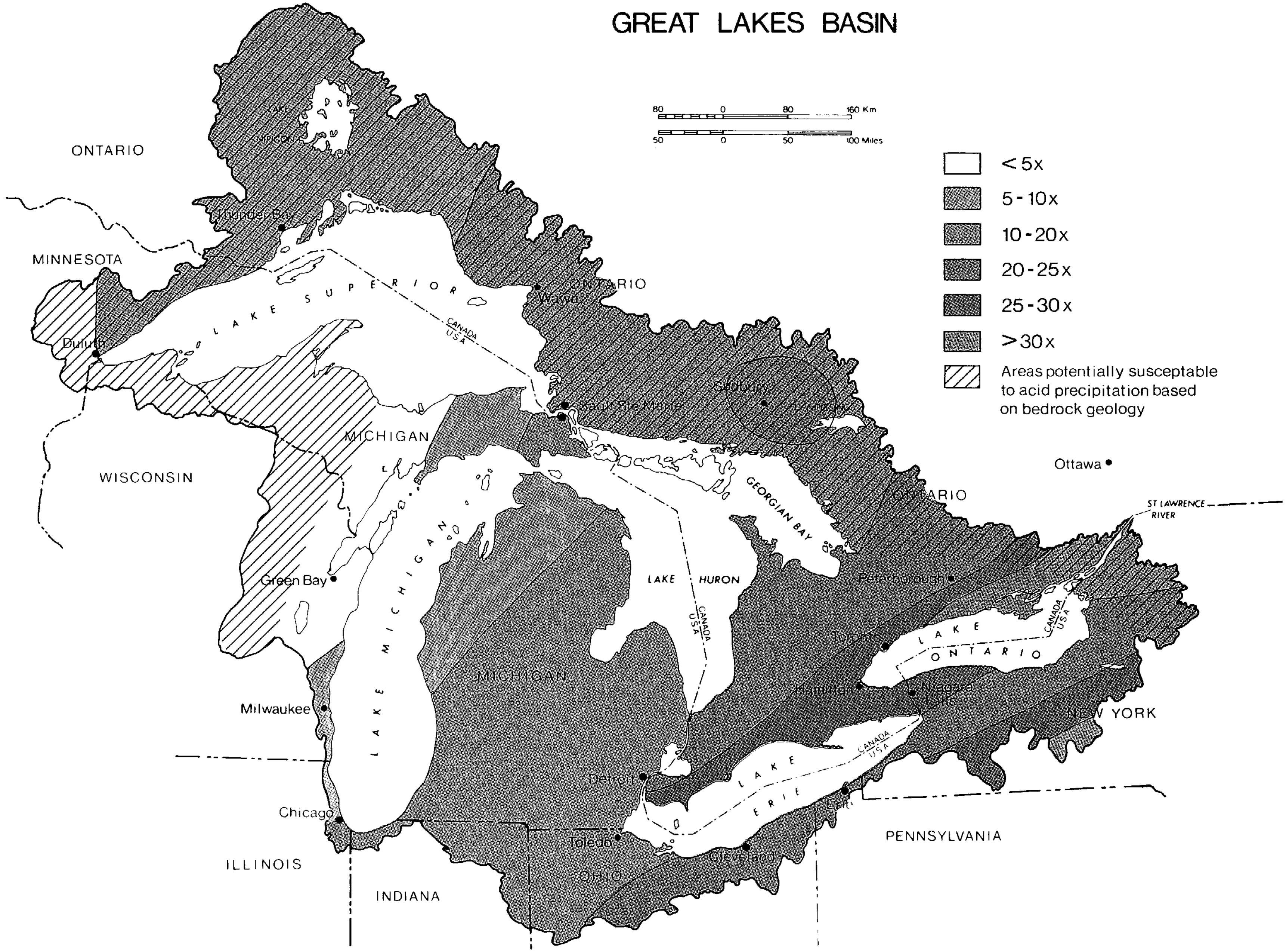

Fig. 2 INCREASED ACIDITY IN BULK PRECIPITATION OVER NATURAL CONCENTRATION (pH 5.7)

foliage (including agricultural crops and forests) and the possibility of the release of toxic heavy metals bound to soils and lake sediments. Further research and monitoring is required to demonstrate these effects in the Great Lakes Basin.

According to the Science Advisory Board, some streams draining to the Great Lakes System have become more acidic and carry high concentrations of heavy metals. These metals may eventually affect spawning areas and may result in an uptake of methylated metals in fish. Dramatic increases in acidity during the spring melt can follow the accumulation of acidic components in the snowpack during the winter months. The increased mobilization of heavy metals could have implications over the long term for the Great Lakes and their fisheries.

The primary sources of the atmospheric emissions of sulphur and nitrogen oxides are the burning of fossil fuels (in manufacturing, heating homes and transportation), and the smelting of sulphur rich ores. The burning of coal by electrical utilities accounts for over half of the sulphur dioxide emitted in the United States, while in Canada the non-ferrous smelting industry is the major source of sulphur dioxide. Fuel combustion by factories, power plants and motor vehicles is the major source of nitrogen oxide emissions in the United States while motor vehicles are the primary source in Canada.

In addition to acid precipitation, the hazards of coal burning and ore smelting without adequate environmental safeguards include direct damage to vegetation, property and human health by SO_2, radionuclides (often exceeding amounts released by nuclear plants), heavy metals and suspended particulates (fly ash). In part, the long range problem is a result of the use of taller smoke stacks to disperse pollutants in higher atmospheric levels. This measure is effective at meeting local ambient air quality standards, but at the same time it allows increased total emissions which aggravate the long range problem.

The reports of both the Science Advisory Board and Water Quality Board indicate that, notwithstanding the massive and diffuse nature of the sources throughout eastern North America, technologies now exist to substantially reduce sulphur dioxide and other emissions to the atmosphere. The cost is known to be very substantial, with early estimates by the Water Quality Board of approximately $5-7 billion annually for the northestern United States and $350 million for eastern Canada, to achieve a 50 percent reduction in sulphur dioxide emission. Even greater reductions may be required to adequately address the acid rain problem. It is becoming clear that, however, the increased use of coal as a fuel for the production of electrical and other power is inevitable in order to help satisfy economic and energy problems. Without stringent pollution controls, however, it is also clear that the increasing dependence upon the use of coal for energy requirements will aggravate the current problems related to atmospheric pollution and produce its own set of attendant long-term economic and environmental costs. Thus, the question is largely one of industrial economics and political will, rather than technology. It is also a question of ensuring adequate, enforceable legislation to provide a regulatory basis for the control of long-range, long-term and transboundary effects, in addition to short-term, local effects of atmospheric pollution. Air pollution control requirements designed to achieve localized ambient air quality standards has generally been the approach under the current U.S. Clean Air Act. In Canada, the problem is not so much providing the legislative basis for controlling long range affects as it is the ability to ensure that Provincial governments, which have the primary control responsibility, take transboundary problems into account in their pollution control requirements.

The Commission urges Governments to consider not only relatively short-term economic goals (regional, national and international), but also the long-term costs to society in both countries of not controlling acid rain and other air pollution problems. Furthermore, the Commission suggests that the costs of pollution control in the case of thermal power generation in both countries should be compared not only with the cost of burning coal without stringent emission controls, but also with the higher real cost of the alternate energy sources in the context of the overall energy supply situation.

The Commission notes that the Governments have initiated considerable bilateral work to address the problems associated with acid rain and other forms of long-range air pollution. It is also aware of the negotiations leading towards an international air quality treaty or agreement, concurrent with the domestic research and more stringent control programs recently announced in both countries.

Nevertheless, while the Commission has in the past communicated with the Governments on the problems of long-range transport of air pollutants under other References, the significance of atmospheric pollution to Great Lakes water quality as reported by the Great Lakes Water Quality and Science Advisory Boards, compel the Commission to advise the Governments of the extent and possible consequences of the acid rain problem to the Great Lakes Basin ecosystem. In this regard, the Commission believes that the potential for impacts on the Great Lakes is sufficient to require consideration of this problem under the provisions of Article VI (1)(e) of the 1978 Great Lakes Water Quality Agreement. There is also a need to clarify and expand on knowledge concerning the linkage between the acid rain problem in the Basin ecosystem and the boundary waters. The Commission recommends that the Governments of the United States and Canada consult in a timely manner on appropriate actions to substantially reduce atmospheric emissions of sulphur and nitrogen oxides from existing as well as new sources, and that the Governments ensure that adequate, comprehensive research programs are underway to provide information on the causes, effects on the ecosystem and measures for the control of the long-range transport of airborne pollutants, with special attention in the near future to acid rain.

(vi) Radioactivity

Overall, the radiological quality of Great Lakes waters has remained essentially unchanged from 1977. Strontium-90, the major source of which is fallout from atmospheric testing of nuclear weapons, is a very important component of the annual dose to man from Great Lakes water. However, the human ingestion of strontium-90, tritium and radium-226 from Great Lakes water remains well below the whole body objective of 1.0 mrem per year. The Commission agrees with its Radioactivity Subcommittee that this objective should remain unchanged, even though the International Commission on Radiological Protection has recommended changes to raise dose limits and thereby permit a higher concentration of most radionuclides in waters.

Present radioactivity surveillance activities appear to be adequate to determine compliance with the radioactivity objective in the 1978 Agreement and to determine trends in the radiological quality of the water. Programs are not adequate, however, for determining the fate of radionuclides in the biota and sediments, or the exposure of man to radionuclides in Great Lakes water, biota and sediment.

While the impact of the nuclear fuel cycle in the Great Lakes Basin has been small to date, there are nevertheless several areas of concern including the milling of ores, storage and disposal of spent fuel, and the decommissioning of power plants. Planning for expansion of mining and milling activities in the Elliott Lake area of Canada is of concern because of the potential for long-term releases of radioactivity from abandoned mill tailings piles. Storage and disposal of spent nuclear fuel is of concern because of the relatively large quantity of spent fuel already generated and because of the limited available storage capacity. The possible impact of the decommissioning of nuclear plants is of concern because it has so far received very little attention. It is a problem which will have to be faced in the foreseeable future.

Because of public sensitivity to the whole matter of nuclear reactor development in the Great Lakes Basin and the concern over unplanned releases ("spills") of radionuclides, the Commission has requested that the following procedures be implemented for reporting such spills to the Commission. After receipt of information at the Commission's Regional Office about a given spill event from the United States Nuclear Regulatory Commission (NRC) or the Canadian Atomic Energy Control Board (AECB), immediate preliminary notification is provided to the Water Quality Board and to the Commission Headquarters in Washington and Ottawa with whatever detailed information is available at that time. If the spill is such that it may violate the radioactivity objective set out in the 1978 GLWQA, the Board is to provide a complete report to the Commission as soon as detailed information is available.

4. GREAT LAKES WATER QUALITY SURVEILLANCE

The general framework of the Great Lakes International Surveillance Plan was recommended to Governments by the Commmission in 1975. The plan was developed by the Water Quality Board to provide a comprehensive, coordinated bilateral approach to assess water quality in the Great Lakes. A primary output of the plan will be information which will assist water quality managers and policy makers in water management and pollution control programs to meet the requirements of the Water Quality Agreement and to permit assessment of such programs. Component programs of this plan, such as the intensive study of Lake Erie, have been implemented during 1978 and 1979.

Annex 11 of the 1978 Agreement states that a surveillance and monitoring program shall be developed and implemented among the Parties and the State and Provincial Governments, and that the Great Lakes International Surveillance Plan shall serve as a model. The Surveillance Plan has been under review and further development by the Water Quality Board to meet the needs of the 1978 Water Quality Agreement. It was originally designed to assess nutrient concentrations, but subsequently has been undergoing modifications in order to address toxic and hazardous substances as well. Further, in 1977, the Science Advisory Board cautioned the Commission that the plan, although useful in determining compliance with water quality requirements, was of limited value as a basis for addressing progress in ecosystem quality. This was because the elements of the plan were static, that is, the interactions and interdependencies of ecological parameters were not considered. Information received by the Commission as a result of surveillance efforts under the 1972 Agreement has been limited to determining material loads and their immediate impacts, resulting in the establishment of "Problem Areas" in the Basin where water quality objectives were exceeded. The 1978 Water Quality Agreement, however, requires that surveillance should not be limited to compliance monitoring but should also be undertaken for the evaluation of water quality trends and the identification of emerging problems in the Great Lakes Basin ecosystem.

The Commission recognizes that constraints on surveillance activities have resulted because of the need for improved sampling techniques (such as measuring atmospheric inputs) and analytical techniques (routine measurement of specific contaminant objectives). The Commission urges that research and program assessment needs be closely coordinated in the implementation of the surveillance program in order to assure the maintenance of expertise, and to integrate research results into the further development and improvement of surveillance activities. For example, as noted previously in this Report, there is a need to review the adequacy of laboratory capabilities within the context of the requirements of the 1978 Agreement and the Great Lakes International Surveillance Plan.

The issue of hazardous and toxic substances requires the development of expanded surveillance and monitoring programs, including lakes and tributaries. Accordingly, it is recommended that the Governments ensure that sufficient funds are available to design properly and implement the programs. It is noted by the Commission that the level of funding for surveillance activities increased only slightly between 1978 and 1979. Unless there is an increase in funding, it is not likely that proper monitoring of the new Specific Objectives can be implemented without adversely affecting on-going surveillance activities.

5. THE COMMISSION AND ITS PERSPECTIVES UNDER THE 1978 AGREEMENT

(i) Role and Organization of Commission Activities

The role of the Commission is recognized as primarily one of monitoring, assessing and subsequently advising the Parties to the Agreement concerning the state of the Great Lakes Basin ecosystem and the adequacy and effectiveness of any measures taken by the various Great Lakes jurisdictions to meet the terms of the Agreement. While this role can be interpreted as being limited functionally, it is, in fact, very broad in the areas that can be considered. Any matters that might affect the quality of the Great Lakes Basin ecosystem, and thereby the quality of the boundary waters of the Great Lakes System, are included in the mandate of the Commission. The Commission has essentially treated this as a continuation of its activities under the 1972 Agreement, albeit with some degree of redirection and expansion pursuant to the provisions of the 1978 Agreement.

The Commission's advisory role is strengthened by provisions for publication by the Commission of any report, statement or document prepared by it under the Agreement. Public scrutiny of both the basis and outcome of the Commission's various deliberations, as well as the reactions of the Governments to these activities, further strengthen this role. The Commission believes that a high degree of candor and openness in such activities is in the long-term interests of both countries.

The Commission has made considerable progress in recent years in the areas of public involvement and awareness. It is currently reviewing its entire public information policy and the degree of public involvement in its activities under the Agreement, in an effort to be more responsive to the needs of the public and the Parties to the Agreement.

The Great Lakes Water Quality Board, the Commission's principal advisor under the Great Lakes Water Quality Agreement, still consists of nine members each from Canada and the United

States, including representatives from the Parties and each of the State and Provincial governments. The substructure of the Board is undergoing review to ensure that it has the organizational capability to meet the requirements of the 1978 Agreement, including its increased emphasis on toxic and hazardous substances. The Commission also wishes to ensure the active interest and involvement of state and provincial agencies, all relevant federal agencies, and local or non-governmental organizations and individuals where needed, in the activities of the Board and the "working" level of the Water Quality Board structure.

The Science Advisory Board (called the Research Advisory Board under the 1972 Agreement) also has a broadened role as the scientific advisor to the Commission and the Great Lakes Water Quality Board. It is responsible for all matters related to research and the development of scientific knowledge pertinent to Great Lakes water quality and ecosystem problems and programs. Several permanent expert committees are appointed by the Board to assist it in its studies, and Task Forces are created for specific assignments. Membership of the Science Advisory Board and its Committees is diverse, both in discipline and employment, consisting of scientists and other informed persons from government, industry, the academic and consulting community, and the general public.

The Great Lakes Regional Office of the Commission was established in 1973 at Windsor, Ontario, to assist the Commission and its Boards in carrying out their Agreement responsibilities. The staffing and the specific functions of this office were reviewed by a team appointed by the Governments during the six months following the signing of the 1978 Agreement. The professional staff provides secretariat support for various Water Quality Board and Science Advisory Board activities. There is also a core group of technical support personnel. The Commission's Great Lakes public information activities are carried out with the assistance of the public information staff in Windsor.

Following the governmental review of the Regional Office, the Commission carried out its own internal review of procedures for the implementation of its responsibilities under the Agreement, so that it might be more keenly aware of the problems and opportunities that lie ahead in fulfillment of the requirements of the 1978 Great Lakes Water Quality Agreement.

(ii) Emerging Perspectives

The Commission expects that, in addition to the changing emphasis in the new Agreement from the "traditional" pollutants to the complexities of a vast array of chemical compounds (e.g., organic chemicals), a number of new environmental perspectives will evolve.

The culmination of the Commission's activities under the Pollution from Land Use Activities Reference provided the Commission with valuable information as to the important contribution of non-point sources of pollution, primarily land drainage or atmospheric inputs from many diffuse land-use activities. It placed a new light on the types of governmental policies and programs needed to deal effectively with pollution of the Great Lakes. Fundamental conclusions of the Commission concerned the need for comprehensive, consistent and coordinated governmental programs to deal with the many factors affecting pollution-generating activities and the increased need for public involvement in the identification and resolution of environmental problems.

In a closely related vein, the expanding awareness of the "ecosystem approach" is fundamental to taking effective action concerning Great Lakes pollution without producing undesirable or unexpected side effects. Not only does this approach lead to a wider search and appreciation for the overall impacts of environmental management decisions and man's activities generally, but it also leads to the need to revise or break down old barriers of analysis and action, which were previously created for geographical, disciplinary, functional or jurisdictional purposes. As an example, we now have a much better quantitative understanding of the magnitude of pollution in the air, water and land sectors of the Great Lakes Basin ecosystem. It is becoming increasingly clear that these three sectors are intimately linked through a complex network of processes and pathways, and that impacts in one segment can have impacts in another segment. A paradox encountered when trying to comprehend the magnitude of man's growing impact on this network of processes and pathways is that details can be extremely important; yet at the same time, one must avoid becoming preoccupied with details to the extent that unifying principles and overall significance are overlooked.

The Commission has embraced the ecosystem approach in its last two reports on Great Lakes water quality and in its report, Pollution in the Great Lakes Basin from Land Use Activities. The PLUARG study, on which the latter was based, documented and quantified many of the direct and indirect linkages between the air, water and land sectors of the Great Lakes Basin ecosystem and showed some of the ways that urban and rural land use activities are affecting each of these sectors. PLUARG entitled its final report Environmental Management Strategy for the Great Lakes System, which reflected the need to develop a more comprehensive management strategy for addressing pollution of the Great Lakes System. The Commission endorsed this conclusion of PLUARG and believes that in the long-term the emphasis must be on the Great Lakes Basin ecosystem, rather than simply on concentrations of pollutants in waters of the five Great Lakes and their connecting channels.

The Commission believes that if the will is there, the United States and Canada can develop a comprehensive strategy to guide economic and social development in the Basin in a manner that protects the integrity and resilience of the Great Lakes Basin ecosystem. Such a strategy, whatever form it takes, must not be inflexible. Our knowledge of environmental quality and the factors which affect it are not yet adequate enough to be inflexible. Flexibility will allow the strategy to be responsive to new information ideas and changing societal attitudes and goals, and yet also allow for the multijurisdictional nature of the challenge and the opportunity for cooperative rather than imposed solutions. It also respects multidisciplinary aspects of the problem and helps ensure that essential inputs from many fields - science, engineering, economics, law, agriculture and others - can be readily incorporated into overall strategies.

Information gathering, synthesis, evaluation and dissemination functions are fundamental to the long-term success of a comprehensive management strategy. Without ready access to adequate information from credible sources, public support for enviromental objectives and programs may be tenuous, and all programs may suffer as a result. Governments should improve these functions and reduce administrative structures that tend to be compartmentalized on an issue or resource basis in order to more effectively gather and provide information on the linkages between each of these sectors.

In this regard, the Commission has noted a number of initiatives concerning innovative approches to information gathering and analysis. Examples include the report by the Great Lakes Fishery Commision on Great Lakes rehabilitation, and the deliberations of the SAB Task Force on Environmental Mapping. In the past, the Commission has supported the concept of an experimental environmental mapping program for part of the Great Lakes Basin, and has recommended governmental support. Support for an extensive environmental mapping effort, however, is not unanimous. Concern appears to revolve in part around possible mis-use of maps which may contain incomplete or misleading information (e.g., if an area is not marked for fish spawning, it may be assumed that the area is not important in this regard) and around competing priorities for the limited research and operating funds in the agencies concerned.

The Commission still believes that such a program would be a valuable tool in Great Lakes management, in producing an understanding of the dynamics and flexibility of the Great Lakes System to incorporate many uses within constraints, and in communication between scientists, resources managers, elected officials and the general public. The Commission again recommends that the Governments sponsor an experimental mapping project in order to determine the problems and benefits associated with such an undertaking.

The Commission has also noted the general paucity of data on the social and economic costs and benefits of pollution control in the Great Lakes Basin ecosystem. There are both values and limitations to this type of analysis. In any event, it is evident that Governments are increasingly requiring socio-economic assessments as one prerequisite to undertaking regulatory or direct-funding programs. The Commission recommended in its Report on Pollution from Land Use Activities that an assessment of the social and economic implications of pollution control be initiated by the Governments and be coordinated internationally for the Great Lakes Basin.

Finally, the Commission draws to the attention of Governments the need for a long-term view of the Great Lakes Basin ecosystem. It is now known that this complex system often reacts slowly but surely to changing stresses of man and nature. So far, actions relating to the GLWQA can be characterized almost exclusively as reactive to problems caused by past and present actions. It is certain that society and its demands on the natural system will continue to change as social values, needs and available resources change, a prime example being the energy "crisis". Too often, however, society is too late to avoid environmental/economic dislocations and preventable damage. If a comprehensive strategy is to be effective, it must have a framework that both allows for short-term decisions and tactics, as well as long-term plans and strategies. Short-term considerations often have a way of assuming an urgency and importance far out of the proportion to their long-term and overall significance. A long-term perspective will help avoid an atmosphere of continuous "crisis" management.

There is considerable value, therefore, in shifting some emphasis towards the future in order to try to anticipate and prevent problems rather than simply react to them. For this reason, the Commission supported a workshop in March 1979, sponsored by its

SAB, on Anticipatory Planning in the Great Lakes Basin. The Commission will review the findings of this workshop with respect to possible Commission actions in the future.

In presenting the above considerations, the Commission recognizes that Governments have made efforts, substantial in some instances, to address these and other related topics. In particular, the emphasis in the 1978 Agreement on the Great Lakes Basin ecosystem reflects the recognition by the Parties that a broader and more long-term environmental perspective is essential. The Commission believes that the 1978 Agreement represents a significant step forward, one which will provide a solid basis for coordinated action in the future toward developing an effective, long-term strategy for effectively managing the Great Lakes Basin ecosystem.

Signed this 10th day of October 1980 as the Commission's Seventh Annual Report on Great Lakes Water Quality

Robert J. Sugarman

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APPENDIX I

Science Advisory Board Proposed Plan for Implementing Annexes 10 and 12 of the 1978 Great Lakes Water Quality Agreement (reproduced for SAB Annual Report, July 1979, pp. 33-351)

"Perhaps any discussion of how to deal with chemical contaminants in the Great Lakes should begin by deciding why these are singled out and what makes them different and need special treatment. Having identified the answer to these questions, then solutions may be more obvious.

One difference that is apparent at the outset is that the chemicals of most concern are those that are most toxic. "Most toxic" for purposes of the Great Lakes must be defined as those for which the exposure--length of time and concentration present--results in the greatest potential for adverse effects. Toxicity is only one characteristic of concern in evaluating the probable exposure: persistence is equally important in assessing hazard. Ozone for example is very toxic but it is much less of a hazard because it persists only for a few seconds or minutes. Others may exert their effect indirectly such as the impact of freons on the ozone layer.

A second difference about the chemicals of concern is that they constitute a vast number and are chemically and physically very different. Furthermore, the total number, the chemical-physical characteristics, the quantity and the sources are poorly known. Neither is it practical to analyze surveillance samples for all or even most of these chemicals. Furthermore, there certainly are many other by-product chemicals associated with the production and use of chemicals in commerce.

From these characteristics, it is clear that any plan to effectively control chemicals must:

(1) consider the toxicity, persistence and quantity produced in the Great Lakes Basin Ecosystem;

(2) contain a mechanism for selecting those of most probable hazard;

(3) contain a priority plan for promoting development of needed data that are lacking - from biological effects to control technology;

(4) idendify locales of most probable occurrence if surveillance needs are to be made realistic.

Accepting these characteristics as important, it is clear that (1) the lists currently in Annex 10 must be revised and (2) a working data base is needed to provide candidate chemicals to the Parties for placement on the lists. These lists are much too rigid and difficult to change to be used as working lists, given the massive lack of information.

Further note that the main characteristics of pollutants identified in Annex 12, are equally important characteristics in Annex 10. As an example, calcium is a persistent substance but was probably not one intended to be considered with special interest under Annex 12. Calcium is at the other extreme from ozone in that it is undestructable but has a very low toxicity and therefore a low hazard. In view of this, the two Annexes should be treated together.

The Science Advisory Board Suggests the following approach towards responding to Annexes 10 and 12:

(1) The Appendices 1 and 2 of Annex 10 should be defined as those chemicals of <u>certain</u> high hazard and <u>suspected</u> high hazard respectively. A task force of the two Boards should be appointed to refine the Appendices based on this definition.

(2) A Science Advisory Board Committee should establish a mechanism to collect, review and synthesize data on chemicals and their interaction in the Great Lakes Basin Ecosystem and recommend to the Water Quality Board placement on list 1 or 2.

(3) The Water Quality Board should establish a mechanism to gather production, transport and discharge data on individual chemicals in the Basin. This step is critical to success of the entire program. Both #2 and #3 would require substantial staff support.

(4) The inventory and data base developed by the Science Advisory Board and the EPA Duluth Laboratory should be used as the working mechanism for processing the massive amount of data that will be generated. Further, the Regional Office in Windsor should be assigned the responsibility of maintaining and updating the base at the direction of the Science Advisory Board Committee identified in #2 above.

(5) The Commission should be responsible to see that proper enforcement and surveillance is achieved by the Parties.

A concerted effort should be expended to assure that all other data basis are examined for useful information. Experience to date suggests they may be useful but not complete for International Joint Commission needs. Many are not yet truly operational.

The above described activity could well become a large part of our water quality objectives activity. Identified data deficiencies will also provide guidance to the Science Advisory Board and the International Joint Commission for needed research to be recommended to governments."

APPENDIX II

PROBLEM AREAS - LAKE SUPERIOR							
Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
JACKFISH BAY [2]	Fish tainting and toxics.	1975	Kimberly Clark of Canada Ltd., Terrace Bay	Ontario	Probable source of tainting and toxics.	Met effluent requirements. New Mill start up in 1978.	Yes.
NIPIGON BAY [3]	Fish tainting and toxics.	1975	Domtar Packaging, Red Rock	Ontario	Probable source of tainting and toxics.	Met effluent requirements. Further reduction in toxicity under review.	Yes.
THUNDER BAY [1]	Dissolved oxygen, coliforms, phenol.	1977	Northern Wood Preservers, Ltd., Thunder Bay	Ontario	A probable source of phenol.	Acceptable phenol treatment in place.	Yes.
			Great Lakes Paper Co., Thunder Bay	Ontario	Source of BOD.	Did not meet effluent requirements. On schedule with approved closed-cycle system in full operation, application of same system to be made to old Kraft Mill.	Yes. But needs to be verified by field surveys.
			Industrial Grain Products Ltd., Thunder Bay	Ontario	Source of BOD.	Did not meet effluent requirements. Control order pending for pretreatment project before discharge to municipal sewer.	Yes. But needs to be verified by field surveys.
			Abitibi Paper Co. Ltd., Thunder Bay (3 mills: Fort William, Thunder Bay, Provincial)	Ontario	Source of BOD.	Did not meet effluent requirements. On schedule with control order. Projects at 3 mills to be completed by 1982.	Yes. But needs to be verified by field surveys.
			Canada Malting Ltd., Thunder Bay	Ontario	Source of BOD.	Began discharge to municipal sewer October 1978.	Yes. But needs to be verified by field surveys.
			Thunder Bay STP	Ontario	Source of BOD and coliforms.	Met effluent requirements. New wastewater treatment plant in operation April 1978.	Yes. But needs to be verified by field surveys.
	Mercury in sediments and fish.		Dow Chemical	Ontario	Past source of mercury.	Mercury process plant closed in 1973.	Yes. Over long term.

1. An area where water quality objectives have not been achieved because remedial programs are not yet completed.
2. An area where remedial programs have been completed, but a delay is expected before conditions in the lake show improvement.
3. An area where further remedial programs may be required.

TABLE 2.6 PROBLEM AREAS - LAKE SUPERIOR

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
MARATHON-PENINSULA HARBOUR [1]	Tainting, toxicity, mercury in fish.	1977	American Can of Canada Ltd., Marathon	Ontario	Source of tainting and toxicity.	Did not meet effluent requirements. On schedule with required program - expected completion 1980. Met 1977 requirement to cease mercury discharge.	Yes.
SILVER BAY [1]	Suspended solids. Includes asbestos fibres and turbidity.	1977	Reserve Mining Co., Silver Bay	Minnesota	Source of suspended solids.	Did not meet effluent requirements. On-land disposal system is under construction. Federal District court ordered completion by Apr. 15/80.	Yes.
DULUTH-SUPERIOR HARBOR [3]	Phosphorus, iron, coliform, total dissolved solids, dissolved oxygen.	1978	Western Superior San.Dist., (WLSSD) Duluth	Minnesota	Source of BOD, coliform, phosphorus.	Met effluent requirements. New plant completed November 1978.	Yes.
			WLSSD Cloquet	Minnesota	Source of BOD, coliform, phosphorus.	Met effluent requirements. Connected to WLSSD December 1978.	Yes.
			Conwed Corp., Cloquet	Minnesota	Source of BOD, phosphorus.	Met effluent requirements. Connected to WLSSD January 1979.	Yes.
			U.S. Steel Corp.. (Duluth Works), Duluth	Minnesota	Source of BOD, phosphorus, total dissolved solids.	Met effluent requirements. Treatment facilities construction completed. Ammonia quench waters recycled. Sanitary waters diverted to WLSSD sewer system. Coke operation will be shut down by 1981.	Yes.
			Potlatch Corp., Cloquet	Minnesota	Source of BOD.	Met effluent requirements. Connected to WLSSD January 1979.	Yes.
(cont'd)			Continental Oil Co., Duluth	Minnesota	Source of BOD.	Met effluent requirements. Connected to WLSSD December 1978.	Yes.

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PROBLEM AREAS - LAKE SUPERIOR

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
DULUTH-SUPERIOR HARBOR (cont'd) [3]			Superior Fibre Prod. Inc., Superior	Wisconsin	Source of BOD.	Met effluent requirements. Wet process hardboard internal recycle and settling lagoons for blowdowns.	Yes.
			Superior STP	Wisconsin	Source of BOD, phosphorus, coliform.	Met effluent requirements. Phosphorus removal facilities satisfactory since May 1978. Satellite treatment plants for handling overflows operational in December 1978. Sewer renovations did not completely correct sewage overflows.	Yes.
MINERAL RIVER [3]	Total dissolved solids.	1977	White Pine Copper Co., White Pine	Michigan	Source of total dissolved solids.	Met effluent requirements.	Problem area being reassessed.
UPPER PORTAGE ENTRY [3]	Copper and zinc in sediments.	1976	Historical mining operation	Michigan	Mine tailings containing copper and zinc.	No remedial programs deemed feasible.	

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PROBLEM AREAS - LAKE HURON

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
SAGINAW BAY [1]	Total dissolved solids, phosphorus, eutrophication.	1978	Alma STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Bay City STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Bridgeport Twp STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Buena Vista Twp STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Combined sewer overflows	Michigan	Source of total dissolved solids.	-	Combined sewer overflows may continue to cause problems during rainfall periods.
			Dow Chem., Bay City	Michigan	Source of solids.	Met effluent requirements.	Yes, over a long period of time.
			Dow Chem., Midland	Michigan	Probable source of total dissolved solids.	Met effluent requirements. $15.37 \times 10^3 m^3/d$ is being discharged via deep disposal wells.	Yes, over a long period of time.
			Flint STP	Michigan	Source of phosphorus.	Did not meet effluent requirements. Notice of violation issued.	Yes, over a long period of time.
			Flushing STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Midland STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
(cont'd)			Monitor Sugar Co., Bay City	Michigan	Source of solids.	Did not meet effluent requirements. Revised permit and final order on public notice.	Yes, over a long period of time.

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PROBLEM AREAS - LAKE HURON

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM-VIOLATION OF OBJECTIVE OR STANDARD	DATE-LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
SAGINAW BAY [1] (cont'd)							
			Mt. Pleasant STP	Michigan	Source of phosphorus.	Did not meet effluent requirements. Failed to start construction Apr. 1978.	Yes, over a long period of time.
			Owosso STP	Michigan	Source of phosphorus.	Did not meet effluent requirements. Not in compliance due to construction delay caused by local court action which has been resolved.	Yes, over a long period of time.
			Saginaw STP	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Saginaw Twp. Sewage District	Michigan	Source of phosphorus.	Met effluent requirements.	Yes, over a long period of time.
			Velsicol Chem. Corp., St. Louis	Michigan	Source of total dissolved solids, phosphorus.	Met effluent requirements.	Yes, over a long period of time.
ALPENA-THUNDER BAY [2]	Suspended solids.	1975	Abitibi Corp., Alpena	Michigan	Source of suspended solids.	Met effluent requirements.	Yes.
HARBOR BEACH [2]	Suspended solids.	1975	Hercules Inc., Harbor Beach	Michigan	Source of suspended solids.	Did not meet effluent requirements.	Yes.
COLLINGWOOD HARBOUR [1]	Nuisance algae.	1978	Collingwood STP	Ontario	Source of phosphorus.	Did not meet effluent requirements. Expansion and improved treatment under design. Operation expected by 1981.	Expect gradual improvement will result from phosphorus control.

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PROBLEM AREAS - LAKE HURON

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
PENETANG BAY [2]	Eutrophication.	1978	Penetanguishene STP	Ontario	Source of phosphorus.	Met effluent requirements.	Expect gradual improvement will result from phosphorus control.
SPANISH RIVER [1]	Fish tainting.	1977	E.B. Eddy Forest Products, Espanola	Ontario	Source of fish tainting.	Did not meet effluent requirements. On schedule with control order. Final phase of measures to reduce BOD and toxicity expected to be completed in late 1985.	Yes.
SERPENT [1] HARBOUR	Radium (^{226}Ra), pH.	1978	Denison Mines Ltd., and Rio Algom Mines, Serpent Harbour	Ontario	Source elevated levels of ^{226}Ra.	Did not meet effluent requirements. Requirement & Directions issued in 1977 for all active and idle mining properties requiring treatment of waste and drainage for removal of radium, heavy metals, nitrates, and stabilization of tailings systems.	Yes. However, long retention time of lakes in Serpent River system will delay achievement of objectives.
ST. MARYS [1] RIVER	Total coliform, phenols, and ammonia.	1978	Sault Ste. Marie STP	Ontario	Probable source of coliform. Source of ammonia.	Met effluent requirements. Program for sewage collection system improvements and treatment modifications to include phosphorus removal adopted recently by City.	Yes.
			Algoma Steel, Sault Ste. Marie	Ontario	Major source of phenols.	Did not meet effluent requirements. By-product recovery plant completed. Plant components being brought into operation, although operating problems have developed. A control order served in June 78 requires further improvements to meet effluent limitations.	Yes.

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PROBLEM AREAS - LAKE MICHIGAN

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
GREEN BAY [1]	Dissolved oxygen, phosphorus, suspended solids.	1977	Wisc. Pub. Service (J.P.Pulliam Plt), Green Bay	Wisconsin	Source of suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			Wisc. Tissue Mills, Menasha	Wisconsin	Source of BOD, suspended solids.	Met effluent requirements.	Yes.
			Nicolet Paper Co., W. DePere	Wisconsin	Source of BOD, suspended solids.	Met effluent requirements.	Yes.
			Riverside Paper Co., Appleton	Wisconsin	Source of BOD, suspended solids.	Met effluent requirements.	Yes.
			Midtec Paper Corp., Kimberley	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			Hammermill Paper Co., Kaukauna	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Kimberley Clark Corp., Neenah	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Kimberley Clark Corp. (Lakeview Mill) Neenah	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Cons. Paper, Appleton	Wisconsin	Source of BOD, suspended solids.	Did not meet effluent requirements.	Yes.
			Bergstrom Paper Co., Neenah	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
(cont'd)							

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PROBLEM AREAS - LAKE MICHIGAN

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
GREEN BAY [1] (cont'd)							
			Ripon STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			Heart of the Valley STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Oshkosh STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Appleton STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Appleton Papers, Combined Locks	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements.	Yes.
			American Can Co., Green Bay	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Fort Howard Paper, Green Bay	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			De Pere STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Menasha Twp. West STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Menasha Twp. East STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Met effluent requirements.	Yes.
			Neenah-Menasha Sewage Commission, Menasha STP	Wisconsin	Source of BOD, suspended solids, phosphorus.	Did not meet effluent requirements. Problem with industrial discharges of suspended solids.	Yes.

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LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
MILWAUKEE [1] HARBOR	Suspended solids, coliform, dissolved oxygen.	1977	Sewage and storm water overflows	Wisconsin	Sources of BOD, suspended solids, coliform.	Court established schedules for operation of control facilities and correction of problem in 1990.	Yes.
WAUKEGAN [1] HARBOR	PCB in sediment.	1979	Outboard Marine, Waukegan	Illinois	Probable source of PCBs. Loss of PCBs from the sediments is a matter presently in litigation.	NPDES Permit imposing no discharge of PCBs is being challenged by discharger. Presently under litigation for past discharges resulting in PCB contamination of bottom sediments and water in Waukegan Harbor.	Both U.S. EPA and the State are involved in an enforcement action against Outboard Marine which is currently before Federal Dist. Court. Technical investigation is being conducted regarding the extent of contamination and remedial effort warranted.
INDIANA HARBOR [1]	Ammonia, phenols.	1977	East Chicago STP	Indiana	Source of ammonia, phenols.	Did not meet effluent requirements. Enforcement action pending.	Combined sewer overflow and other nonpoint source pollution will possibly be the remaining problems.
			Gary STP	Indiana	Source of ammonia, phenols.	Did not meet effluent requirements. Consent order requires full secondary treatment by Apr. 79. Operation and maintenance problems continue.	Combined sewer overflow and other nonpoint source pollution will possibly be the remaining problems.
			Hammond STP	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Combined sewer overflow and other nonpoint source pollution will possibly be the remaining problems.
			Energy Coop, East Chicago	Indiana	Source of ammonia, phenols.	Did not meet effluent requirements. Hearing held and order pending.	Yes.
			Youngstown Sheet & Tube, East Chicago	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Yes.
			American Oil Company, Whiting	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Yes.
(cont'd)							

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Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
INDIANA HARBOR [1] (cont'd)							
			U.S. Steel, Gary	Indiana	Source of ammonia, phenols.	Met effluent requirements. Final limits to be attained 1980.	Yes.
			Inland Steel, East Chicago	Indiana	Source of ammonia, phenols.	Met effluent requirements.	Yes.

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PROBLEM AREAS - LAKE ERIE

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
ST. CLAIR [1] RIVER	Tainting of fish, toxic substances.	1977	CIL, Courtright	Ontario	Source of ammonia.	Met effluent requirements.	Yes.
	Note: Dissolved organic discharges from all municipal and industrial sources along St. Clair River under study to establish by 1979 significance of tainting and toxic compounds. Remedial program requirements will be established based on results of study.		Ethyl Corp., Corunna	Ontario	Source of lead.	Met effluent requirements.	Yes.
			Esso Chemical, Sarnia	Ontario	Source of organics and phenols.	Did not meet effluent requirements. Approved program for reduction of dissolved organics, phenols completed.	Yes.
			Imperial Oil, Sarnia	Ontario	Source of organics, phenols and ammonia.	Met effluent requirements.	Yes.
			Shell, Corunna	Ontario	Source of organics, phenols and ammonia.	Met effluent requirements. Proceeding with agreed program to further reduce suspended solids.	Yes.
			Polysar, Sarnia	Ontario	Source of organics, phenols and ammonia.	Did not meet effluent requirements. On schedule with required program. Stage 1 - program completion 1978. Stage 2 requires further study.	Yes.
			Dow Chemical, Sarnia	Ontario	Source of organics and ammonia.	Met effluent requirements. Chlorine recycling proceeding. Company voluntarily seeking further reduction in chlorine.	Yes.
			Sun Oil, Sarnia	Ontario	Source of organics, phenols and ammonia.	Met effluent requirements.	Yes.
THAMES RIVER [3]	Total dissolved solids.	1975	Upstream drainage	Ontario	Sources not identified.	-	-
LAKE ST. CLAIR [2]	Mercury in fish and sediment.	1976	-	Ontario	-	Discharges of mercury from the Sarnia area were discontinued in 1970.	Yes.
WHEATLEY [1] HARBOUR	Coliform, dissolved oxygen.	1978	Omstead Foods Ltd., Wheatley	Ontario	Probable source of BOD.	Did not meet effluent requirements. Facility installed in Sept. 1977; performance to be evaluated in 1979.	Yes.

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Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
DETROIT RIVER [1]	Coliform, phenols, iron, total dissolved solids.	1978	Detroit STP	Michigan	Source of coliform, phenols, total dissolved solids, phosphorus.	Did not meet effluent requirements. The City is presently under a Consent Judgement which outlines effluent quality requirements. These become increasingly more stringent until Dec. 31/81 when full secondary capacity with phosphorus removal is mandated.	Yes.
			Ford Motor Co., Rouge Complex, Dearborn	Michigan	Source of phenols, iron.	Did not meet effluent requirements. Notices of violation issued.	Yes.
			Gt. Lakes Steel, National Steel (4 plants), River Rouge & Ecorse	Michigan	Source of phenols, iron.	Did not meet effluent requirements. Notices of violation issued.	Yes.
			Pennwalt Corp., East & West Plants, Wyandotte	Michigan	Source of total dissolved solids, iron, phenols.	Did not meet effluent requirements. Referral to State Attorney General.	Yes.
			Trenton STP	Michigan	Source of coliform, phosphorus.	Did not meet effluent requirements. Notice of noncompliance issued.	Yes.
			Wayne County STP, Wyandotte	Michigan	Source of coliform, phosphorus.	Did not meet effluent requirements. Notice of noncompliance issued.	Yes.
			Wayne County STP, Trenton	Michigan	Source of coliform, phosphorus.	Met effluent requirements.	Yes.
(cont'd)							

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PROBLEM AREAS - LAKE ERIE

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
DETROIT RIVER [1] (cont'd)							
			Combined sewer overflows	Michigan	Source of coliform, total dissolved solids.	-	Combined sewer overflows may continue to cause problems during rainfall periods.
			BASF Wyandotte Corp., North & South Works, Wyandotte	Michigan	Source of total dissolved solids.	Did not meet effluent requirements. Complaint filed in State Court Sept. 9/78.	Yes.
			BASF Wyandotte Corp., Fighting Island	Ontario	Source of total dissolved solids.	Met effluent requirements.	No economic technology available for further reduction of dissolved solids.
			Allied Chemical Canada Ltd., Amherstburg	Ontario	Source of total dissolved solids.	Met effluent requirements.	No economic technology available for further reduction of dissolved solids.
			Amherstburg STP	Ontario	Source of phosphorus, coliform.	Did not meet effluent requirements. Sewage treatment improvements under review.	Yes.
			Belle River STP	Ontario	Source of coliform, phosphorus.	Met effluent requirements.	Yes.
			Canadian Salt Co. Ltd., Windsor	Ontario	Source of total dissolved solids.	Met effluent requirements.	Yes.
			Chrysler Canada Ltd., Windsor	Ontario	Source of solids.	Met effluent requirements.	Yes.
(cont'd)							

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3. An area where further remedial programs may be required.

PROBLEM AREAS - LAKE ERIE

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
DETROIT RIVER [1] (cont'd)			Ford Motor Co. Ltd., Windsor	Ontario	Source of phenols, total dissolved solids, iron.	Met effluent requirements.	Yes.
			Windsor-Little River STP	Ontario	Source of solids, coliform, phosphorus.	Met effluent requirements.	Yes.
			Windsor Westerly STP	Ontario	Source of coliform, phosphorus.	Met effluent requirements. Plant expansion scheduled for completion in 1982.	Yes.
CLINTON [1] RIVER	Fecal coliform, total dissolved solids.	1977	General Electric, Warren	Michigan	Source of dissolved solids.	Met effluent requirements.	Problem area being reassessed.
		1977	Mt. Clemens STP	Michigan	Source of coliform.	Did not meet effluent requirements.	Problem area being reassessed.
		1977	Rochester STP	Michigan	Source of coliform.	Did not meet effluent requirements.	Problem area being reassessed.
		1977	Pontiac STP	Michigan	Source of coliform.	Met effluent requirements.	Problem area being reassessed.
		1977	Warren STP	Michigan	Source of coliform.	Did not meet effluent requirements.	Problem area being reassessed.
		1977	Combined sewer overflows	Michigan	Source of coliform.	Interceptor collapsed, discharged to river during 1978. Now repaired.	Combined sewer overflows may continue to cause problems during rainfall periods.
TOLEDO AREA [1]	Algae, coliform, dissolved oxygen.	1978	Toledo STP	Ohio	Major point source of BOD, phosphorus, coliform.	Did not meet effluent requirements.	Upstream nonpoint sources and combined sewer overflows will continue to to cause problems.
GRAND RIVER [3]	Total dissolved solids.	1978	Upstream drainage	Ontario	Source of dissolved solids.	No remedial program planned.	-

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PROBLEM AREAS - LAKE ERIE

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
CLEVELAND [1] AREA	Dissolved oxygen, coliform, phenols, heavy metals, fluoride, MBAS.	1977	Cleveland Electric Illuminating, Cleveland	Ohio	Source of heavy metals.	Did not meet effluent requirements. Permit conditions being contested.	Yes.
			Dupont DeNemours, Cleveland	Ohio	Source of metals, ammonia.	Met effluent requirements. Permit conditions being contested.	Yes.
			Republic Steel, Cleveland	Ohio	Source of metals, phenols, ammonia.	Met effluent requirements. Permit conditions being contested.	Yes.
			Jones & Laughlin, Cleveland	Ohio	Source of phenols, metals, ammonia, cyanides.	Met effluent requirements. Permit conditions being contested.	Yes.
			Harshaw Chemical, Cleveland	Ohio	Source of heavy metals, ammonia.	Met effluent requirements.	Yes.
			Cleveland Regional Sewerage Dist. Easterly STP, Cleveland	Ohio	Source of BOD, phosphorus, coliform.	Met effluent requirements. Plant currently being upgraded. Completion date, 1982.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.
			Cleveland Regional Sewerage Dist. Southerly STP, Cleveland	Ohio	Major source of BOD, phosphorus, coliform, ammonia.	Did not meet effluent requirements. Being upgraded. Construction completion 1982.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.
(cont'd)			Cleveland Regional Sewerage Dist. Westerly STP, Cleveland	Ohio	Source of BOD, phosphorus, coliform.	Did not meet effluent requirements. Treatment construction completion expected 1982.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.

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3. An area where further remedial programs may be required.

PROBLEM AREAS - LAKE ERIE							
Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
CLEVELAND AREA [1] (cont'd)			Akron STP	Ohio	Source of BOD, phosphorus, coliform.	Did not meet effluent requirements. State warning issued.	Combined sewer overflow problem will remain although proposed and current improvements will contribute greatly to betterment of water quality.
			U.S. Steel, Cleveland	Ohio	Source of metals.	Met effluent requirements. Ceased discharging Oct. 78.	Yes.
SANDUSKY [3] RIVER	Algae, coliform, dissolved oxygen, copper.	1978	Fremont STP	Ohio	Major source of BOD, phosphorus, coliform.	Met effluent requirements.	Upstream nonpoint sources and combined sewer overflows will continue to cause problems.
HURON RIVER [1]	Total organic nitrogen, chemical oxygen demand, manganese, arsenic.	1978	Huron STP	Ohio	Source of BOD, nitrogen.	Met effluent requirements. Will be upgraded to secondary treatment.	Yes.
BLACK RIVER [3]	Coliform, ammonia, dissolved oxygen, phenol, metals.	1978	U.S. Steel, Lorain	Ohio	Major source of ammonia, phenol.	Did not meet effluent requirements.	Yes.
			Lorain STP	Ohio	Major source of BOD, phosphorus.	Did not meet effluent requirements.	Nonpoint sources, stormwater and combined sewer overflows may still cause problems.
			Elyria STP	Ohio	Secondary source of BOD, phosphorus.	Did not meet effluent requirements. State warning sent.	Nonpoint sources, stormwater and combined sewer overflows may still cause problems.
GRAND RIVER [3]	Total dissolved solids, phenols.	1975	-	Ohio	-	-	-
CONNEAUT [2] RIVER	Dissolved oxygen, total dissolved solids, iron, zinc.	1978	Conneaut STP	Ohio	Source of BOD, iron, zinc.	Met effluent requirements.	Yes.

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PROBLEM AREAS - LAKE ERIE

Problem area determined by field surveys in boundary waters.			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
ROCKY RIVER [3]	Coliform, dissolved oxygen, ammonia.	1978	Lakewood STP	Ohio	Source of BOD, coliform ammonia.	Met effluent requirements.	Yes.
			Rocky River STP	Ohio	Source of BOD, coliform, ammonia.	Met effluent requirements.	Yes.
			Combined sewer overflows	Ohio	Source of BOD, coliform.	-	Combined sewer overflows continue to cause problems.
ASHTABULA [1] RIVER	Chloride, total dissolved solids, iron, zinc, copper, lead.	1978	RMI, Ashtabula	Ohio	Source of total dissolved solids, chlorine.	Did not meet effluent requirements.	Yes.
			Ashtabula STP	Ohio	Source of metals.	Did not meet effluent requirements. Pre-treatment is planned for industries discharging to municipal sewers.	Yes.
			Union Carbide, Ashtabula	Ohio	Source of dissolved solids and metals.	Met effluent requirements.	Yes.
PRESQUE [1] ISLE BAY	Dissolved oxygen, coliform.	1978	Combined sewer overflows	Pennsylvania	Source of BOD, coliform.	Bond issue floated by City of Erie to resolve portions of problem.	No, only a portion thereof, phased program to correct problems dependent upon availability of funds.

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PROBLEM AREAS - LAKE ONTARIO

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
BUFFALO RIVER [3]	Coliform. Note: Industries are listed because of phenol discharges which contribute to the Niagara River water quality problems.	1977	Mobil Oil Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. Will eventually discharge to municipal system.	Yes.
			Republic Steel Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. Adjudicatory hearing held. ECSL issued. New compliance date-April 1980.	Yes.
			Buffalo Color Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. Remedial facilities have been completed.	Yes.
			Donner-Hanna Coke Corp., Buffalo	New York	Source of phenols.	Met effluent requirements.	Yes.
			Bethlehem Steel, Hamburg	New York	Source of phenols.	Met effluent requirements.	Yes.
			Buffalo, Combined sewer overflows	New York	Probable source of phenols. Source of coliform.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
UPPER [3] NIAGARA RIVER	Coliform, phenols.	1977	Buffalo S.A. STP	New York	Source of coliform.	Met effluent requirements. New secondary plant under construction. Expected completion Sept. 1979.	Yes.
	Note: Problem area is affected by discharges to the Buffalo River.		Tonawanda (T) STP #2	New York	Source of coliform.	Met effluent requirements. New secondary facility completed and in operation August 1978.	Yes.
(cont'd)			Tonawanda (C) STP	New York	Source of coliform.	Connected to Tonawanda (T) STP January 1979.	Yes.

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PROBLEM AREAS - LAKE ONTARIO

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
UPPER NIAGARA RIVER [3] (cont'd)			Grand Island Biological Co., Six Mile Cr.	New York	Source of phenols.	Met effluent requirements.	Yes.
			General Motors Corp., Chevrolet Motor Div., Tonawanda	New York	Source of phenols.	Met effluent requirements.	Yes.
			Hooker Chemical & Plastics Corp., Niagara Falls	New York	Source of phenols.	Met effluent requirements. Discharge permit was modified in late 1977 which significantly reduced effluent limits for halogenated organics, added a new limit for mirex and required that a detailed monitoring program be conducted to identify quantities and source of additional substances.	Yes.
			Allied Chemical Corp., Semet-Solvay, Tonawanda	New York	Source of phenols.	Met effluent requirements.	Yes.
			National Steel Corp., Buffalo	New York	Source of phenols.	Met effluent requirements. ECSL issued compliance date September 1979.	Yes.
			Ashland Oil Inc., Tonawanda	New York	Source of phenols.	Met effluent requirements. To connect to municipality.	Yes.
			Buffalo, Combined sewer overflow	New York	Probable source of phenols; source of coliform.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.

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PROBLEM AREAS - LAKE ONTARIO

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM-VIOLATION OF OBJECTIVE OR STANDARD	DATE-LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
LOWER [1] NIAGARA RIVER	Coliform, phenols. Note: Problem area is affected by discharges to the Buffalo and Upper Niagara Rivers.	1977	Lewiston STP	New York	Source of coliform.	Connected to Lewiston Master Sewer Improvement Area January, 1979.	Yes.
			Niagara Falls STP	New York	Source of coliform.	Did not meet effluent requirements. New facility experiencing operational problems due to industrial waste and excess flows. To be fully operational by 1980.	Yes.
			Niagara Falls, Combined sewer overflows	New York	Source of coliform; probable source of phenols.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
			Stamford Niagara Falls STP	Ontario	Probable source of coliform.	Met effluent requirements. Expansion to 12.5 MIGD under construction for future growth of municipality. Fully operational by 1980.	Yes.
LAKE ONTARIO [3] SHORELINE FROM MOUTH OF NIAGARA RIVER TO 18 MILE CREEK	Total coliform.	1976	Municipal discharges to the Niagara River are contributing to water quality problems along the Lake Ontario shoreline.	New York, Ontario	Source of coliform.	Direct discharges from municipal treatment plants in Niagara-on-the-Lake and 2 plants in St. Catharines are satisfactory.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
MISSISSAUGA-[1] CLARKSON AREA	Phenols.	1978	Gulf Oil Ltd., Mississauga	Ontario	Source of phenols.	Did not meet effluent requirements.	Possible modification of present remedial program under investigation.

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PROBLEM AREAS - LAKE ONTARIO

Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements.				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
ROCHESTER [3] EMBAYMENT	Coliform.	1977	Irondequoit STP	New York	Source of coliform.	Being served by Rochester Frank Van Lare STP. Phased out October, 1978.	Yes.
			Rochester, Frank Van Lare STP	New York	Source of coliform.	Met effluent requirements.	Yes.
			Rochester, Combined sewer overflows	New York	Source of coliform.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
OSWEGO HARBOR [3]	Chloride, nitrate.	1977	Oswego East Side STP	New York	Probable source of chloride, nitrate.	Met effluent requirements. Requested 301(i) extension to prepare industrial waste ordinance.	Yes.
			Oswego West Side STP	New York	Probable source of chloride, nitrate.	Secondary facilities completed late 1978.	Yes.
			Miller Brewing Co., Oswego	New York	Probable source of nitrate.	Met effluent requirements.	Yes.
			Osewgo, Combined sewer overflows	New York	Probable source of chloride, nitrate.	Abatement measures under study.	Combined sewer overflows, which generally have longer range abatement schedules, will continue to cause problems during rainfall periods.
			Natural drainage	New York	Source of chloride, nitrate.	Natural geological conditions and land runoff from the Seneca-Oneida-Oswego River Basin.	Natural conditions are the primary cause of problems.
TORONTO [1] HARBOUR & WATERFRONT	Coliform, algae.	1978	Combined sewer overflows	Ontario	Source of BOD, phosphorus.	Completion of automated interceptor controls expected in 1980 when plant is completed.	Yes.

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PROBLEM AREAS - LAKE ONTARIO							
Problem area determined by field surveys in boundary waters			Discharges of one or more of the substances identified in the problem area. Individual discharges may be currently in compliance with agency requirements				Assessment of whether or not completion of remedial programs for the dischargers identified will correct the problem.
LOCATION	PROBLEM - VIOLATION OF OBJECTIVE OR STANDARD	DATE - LAST SURVEY	NAME OF DISCHARGER	JURISDICTION	SUBSTANCES DISCHARGED	STATUS OF REMEDIAL PROGRAMS	
HAMILTON HARBOUR [1]	Iron, algae, coliform, dissolved oxygen.	1978	Hamilton STP	Ontario	Source of coliform, phosphorus.	Did not meet effluent requirements. Facility expansion completed Jul. 79.	Yes.
			Stelco, Hamilton	Ontario	Source of iron, phosphorus, BOD.	Did not meet effluent requirements. Not on schedule with agreed program. Start up of filtration plant delayed till 1979.	Yes.
			Dofasco, Hamilton	Ontario	Source of iron, phosphorus, BOD.	Did not meet effluent requirements. On schedule with agreed program. Studies underway to expand hot mill filtration plant.	Yes.
			Dundas STP	Ontario	Probable source of coliform, BOD, phosphorus.	Met effluent requirements. Plant expansion to 18,000 m3/d completed in 1978.	Yes.
BAY OF QUINTE/[1] ADOLPHUS BEACH	Algae, dissolved oxygen.	1978	Domtar Packaging, Trenton	Ontario	Source of BOD, phosphorus.	Did not meet effluent requirements. On schedule with agreed program. High phenols under investigation.	Yes.
			Trent Valley Paperboard, Glen Miller	Ontario	Source of BOD, phosphorus.	Met effluent requirements.	Yes.
			Belleville STP	Ontario	Source of BOD, phosphorus.	Met effluent requirements. Gradual improvement is expected as a result of phosphorus control and facility expansion completed in 1979.	Yes.
GRASS RIVER [3] (St. Lawrence River)	PCBs.	1977	Under investigation.	New York	PCBs.	Ban use of PCBs.	-

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APPENDIX III

TABLE 1

MUNICIPAL DISCHARGERS TO THE GREAT LAKES SYSTEM HAVING PHOSPHORUS LOADS GREATER THAN 100 KG (220 LB) PER DAY RANKED BY PHOSPHORUS LOAD

RANK	FACILITY	JURIS-DICTION	BASIN	FLOW 10^3 M^3/D	(MG/D*)	P-LOAD KG/D	(LB/D)	P-CONC MG/L
1	Detroit STP	MI	Erie	2469	(652.2)	7179	(15827)	2.91
2	Buffalo S.A. STP	NY	Ontario	705	(186.2)	1771	(3904)	2.51
3	Euclid STP	OH	Erie	113	(29.9)	1573	(3468)	13.92
4	Cleveland Southerly STP	OH	Erie	377	(99.6)	1203	(2652)	3.19
5	Toledo STP	OH	Erie	317	(83.5)	747	(1647)	2.36
6	Syracuse Metro STP	NY	Ontario	221	(58.4)	613	(1351)	2.77
7	Toronto Main STP	ON	Ontario	763	(201.6)	567	(1250)	0.74
8	Hamilton STP	ON	Ontario	237	(62.6)	498	(1098)	2.10
9	Grand Rapids STP	MI	Michigan	179	(47.3)	466	(1027)	2.60
10	Erie STP	PA	Erie	195	(51.5)	433	(955)	2.22
11	Cleveland Westerly STP	OH	Erie	111	(29.3)	400	(882)	3.60
12	Milw Sewer Comm South Shore	WI	Michigan	308	(81.4)	380	(838)	1.23
13	Akron STP	OH	Erie	315	(84.0)	380	(838)	1.21
14	Toronto Humber STP	ON	Ontario	377	(99.6)	377	(831)	1.00
15	Lorain STP	OH	Erie	60	(15.9)	370	(816)	6.17
16	Rochester STP (Frank Van Lare)	NY	Ontario	313	(82.7)	336	(741)	1.07
17	Wayne Co. DPW STP	MI	Erie	299	(79.0)	299	(659)	1.00
18	Kalamazoo STP	MI	Michigan	120	(31.7)	292	(644)	2.43
19	Cleveland Easterly STP	OH	Erie	485	(128.1)	289	(637)	0.60
20	Wyoming STP	MI	Michigan	49	(13.2)	278	(613)	5.63
21	Gary STP	IN	Michigan	152	(40.4)	275	(606)	1.80
22	Thunder Bay STP	ON	Superior	72	(19.0)	250	(551)	3.47
23	Niagara Falls STP	NY	Ontario	125	(33.0)	244	(538)	1.96
24	Tonawanda STP #2 (T)	NY	Ontario	59	(15.6)	243	(536)	4.14
25	Elyria STP	OH	Erie	31	(8.2)	243	(536)	7.76
26	West Lake Superior S D (WLSSD)	MN	Superior	65	(17.2)	233	(514)	3.58
27	Cornwall STP	ON	St Lawre	53	(14.0)	218	(481)	4.11
28	Sault Ste. Marie STP	ON	Huron	44	(11.6)	207	(456)	4.70
29	Milw Sewer Comm Jones Island	WI	Michigan	496	(131.0)	204	(450)	0.41
30	Flint STP	MI	Huron	86	(22.7)	182	(401)	2.12
31	Lakeview STP	ON	Ontario	171	(45.2)	177	(390)	1.04
32	Oshawa Harmony Crk. STP	ON	Ontario	52	(13.7)	156	(344)	2.99
33	Findlay STP	OH	Erie	30	(7.9)	155	(342)	5.23
34	Highland Creek STP	ON	Ontario	127	(33.5)	152	(335)	1.20
35	WM T Field STP	NY	Ontario	30	(7.9)	140	(309)	4.61
36	Rochester Gates-Chili STP	NY	Ontario	48	(12.7)	140	(309)	2.93

RANK	FACILITY	JURIS-DICTION	BASIN	FLOW 10^3 M^3/D	(MG/D*)	P-LOAD KG/D	(LB/D)	P-CONC MG/L
37	Amherst S.D. 16	NY	Ontario	39	(10.3)	131	(289)	3.35
38	Sheboygan STP	WI	Michigan	41	(10.8)	125	(276)	3.04
39	Green Bay STP	WI	Michigan	125	(33.0)	125	(276)	1.00
40	Ann Arbor STP	MI	Erie	129	(34.0)	122	(269)	0.94
41	Racine Water Wastewater Util	WI	Michigan	96	(25.4)	117	(258)	1.22
42	Genessee Co. Drain Comm	MI	Huron	81	(21.4)	113	(249)	1.40
43	Hammond STP	IN	Michigan	138	(36.5)	113	(249)	0.82
44	Solon STP	OH	Erie	6	(1.6)	108	(238)	17.80
45	Skyway STP	ON	Ontario	60	(15.9)	108	(238)	1.80

P-Load = Reported Load in 1978
P-Conc = P-Load/Flow
Ranked by P-Load
*U.S. Gallons
Includes all Municipal Plants with P-Load Greater Than 100 KG/D

APPENDIX III
TABLE 2
MUNICIPAL PHOSPHORUS DISCHARGERS TO THE GREAT LAKES SYSTEM HAVING FLOWS
GREATER THAN 3800 M^3 (1 x 10^6 GALLONS) PER DAY
RANKED BY AMOUNT THAT PHOSPHORUS LOADS EXCEED THAT AT 1.0 MG/L

RANK	FACILITY	JURISDICTION	BASIN	FLOW 10^3 M^3/D	FLOW (MG/D*)	P-LOAD KG/D	P-LOAD (LB/D)	P-CONC MG/L	RANKED LOAD KG/D	RANKED LOAD (LB/D)
1	Detroit STP	MI	Erie	2469	(652.2)	7179	(15827)	2.91	4710	(10384)
2	Euclid STP	OH	Erie	113	(29.9)	1573	(3468)	13.92	1460	(3219)
3	Buffalo S.A. STP	NY	Ontario	705	(186.2)	1771	(3904)	2.51	1066	(2350)
4	Cleveland Southerly STP	OH	Erie	377	(99.6)	1203	(2652)	3.19	827	(1823)
5	Toledo STP	OH	Erie	317	(83.7)	747	(1647)	2.36	430	(948)
6	Syracuse Metro STP	NY	Ontario	221	(58.4)	613	(1351)	2.77	391	(862)
7	Lorain STP	OH	Erie	60	(15.9)	370	(816)	6.17	310	(683)
8	Cleveland Westerly STP	OH	Erie	111	(29.3)	401	(884)	3.60	289	(637)
9	Grand Rapids STP	MI	Michigan	179	(47.3)	400	(1027)	2.60	287	(633)
10	Hamilton STP	ON	Ontario	237	(62.6)	498	(1080)	2.10	261	(575)
11	Erie STP	PA	Erie	194	(51.2)	433	(955)	2.22	238	(525)
12	Wyoming STP	MI	Michigan	49	(12.9)	278	(613)	5.63	229	(504)
13	Elyria STP	OH	Erie	31	(8.2)	243	(536)	7.76	211	(465)
14	Tonawanda STP #2 (T)	NY	Ontario	59	(15.6)	243	(536)	4.14	185	(408)
15	Thunder Bay STP	ON	Superior	72	(19.0)	250	(551)	3.47	178	(392)
16	Kalamazoo STP	MI	Michigan	120	(31.7)	292	(644)	2.43	172	(379)
17	West Lake Superior S D (WLSSD)	MN	Superior	65	(17.2)	233	(514)	3.58	168	(370)
18	Cornwall STP	ON	St Lawre	53	(14.0)	218	(481)	4.11	165	(364)
19	Sault Ste. Marie STP	ON	Huron	44	(11.6)	207	(456)	4.70	163	(359)
20	Findlay STP	OH	Erie	30	(7.9)	155	(342)	5.23	125	(276)
21	Gary STP	IN	Michigan	152	(40.2)	275	(606)	1.80	123	(271)
22	Niagara Falls STP	NY	Ontario	125	(33.0)	244	(538)	1.96	119	(262)
23	WM T Field STP	NY	Ontario	30	(7.9)	140	(309)	4.61	110	(243)
24	Oshawa Harmony Crk STP	ON	Ontario	52	(13.7)	156	(344)	2.99	104	(229)
25	Solon STP	OH	Erie	6	(1.6)	108	(238)	17.80	102	(225)
26	Flint STP	MI	Huron	86	(22.7)	182	(401)	2.12	96	(212)
27	Rochester Gates-Chili STP	NY	Ontario	48	(12.7)	140	(309)	2.93	92	(203)
28	Amherst S.D. 16	NY	Ontario	39	(10.3)	131	(289)	3.35	92	(203)
29	Sheboygan STP	WI	Michigan	41	(10.8)	125	(276)	3.04	84	(185)
30	Bryan STP	OH	Erie	6	(1.6)	78	(172)	12.20	72	(159)
31	Milw Sewer Comm South Shore	WI	Michigan	308	(81.4)	380	(838)	1.23	72	(159)
32	Brookpark STP	OH	Erie	4	(1.1)	73	(161)	18.58	69	(152)
33	Bucyrus STP	OH	Erie	6	(1.6)	72	(159)	12.29	66	(146)
34	Akron STP	OH	Erie	315	(83.2)	380	(838)	1.21	65	(143)
35	Mt Clemens STP	MI	Erie	4	(1.1)	68	(150)	15.89	64	(141)
36	Batavia STP	NY	Ontario	11	(2.9)	74	(163)	6.51	63	(139)
37	Wapakoneta STP	OH	Erie	6	(1.6)	63	(139)	11.27	57	(126)

RANK	FACILITY	JURIS-DICTION	BASIN	FLOW 10^3 M^3/D)	(MG/D*)	P-LOAD KG/D	(LB/D)	P-CONC MG/L	RANKED LOAD KG/D	(LB/D)
38	Adrian STP	MI	Erie	13	(3.4)	67	(148)	5.21	54	(119)
39	Midland STP	ON	Huron	9	(2.4)	62	(137)	7.21	53	(117)
40	Skyway STP	ON	Ontario	60	(15.8)	108	(238)	1.80	48	(106)
41	Canton STP	NY	St. Law	7	(1.8)	51	(112)	7.26	44	(97)
42	Newfane STP	NY	Ontario	8	(2.1)	52	(115)	6.20	43	(95)
43	Davis Rd STP	NY	Ontario	13	(3.4)	56	(123)	4.30	43	(95)
44	Marquette STP	MI	Superior	13	(3.4)	52	(115)	4.12	40	(88)
45	N Tonawanda STP	NY	Ontario	26	(6.9)	65	(143)	2.49	39	(86)
46	Battle Creek STP	MI	Michigan	48	(12.7)	86	(190)	1.80	38	(84)
47	Wetzel Rd STP	NY	Ontario	16	(4.2)	54	(119)	3.42	38	(84)
48	Manitowoc STP	WI	Michigan	32	(8.5)	69	(152)	2.17	37	(82)
49	Kent STP	OH	Erie	10	(2.6)	47	(104)	4.68	37	(82)
50	Appleton STP	WI	Michigan	54	(14.3)	90	(198)	1.66	36	(79)
51	NSSD Waukegan Plant	IL	Michigan	57	(15.1)	91	(201)	1.62	35	(77)
52	Tecumseh STP	MI	Erie	4	(1.1)	38	(84)	9.10	34	(75)
53	Sault Ste. Marie STP	MI	Huron	15	(4.0)	49	(108)	3.20	34	(75)
54	Genessee Co. Drain Comm	MI	Huron	81	(21.4)	113	(249)	1.40	32	(71)
55	Painsville STP	OH	Erie	15	(4.0)	46	(101)	3.03	31	(68)
56	Corbett Creek STP	ON	Ontario	10	(2.6)	40	(88)	4.18	30	(66)
57	Lake Co Mentor S D	OH	Erie	24	(6.3)	52	(115)	2.21	29	(64)
58	Cloquet STP (WLSSD)	MN	Superior	9	(2.4)	37	(82)	4.05	28	(62)
59	Ithaca STP	NY	Ontario	30	(8.0)	58	(128)	1.91	28	(62)
60	Val Caron STP	ON	Huron	5	(1.3)	32	(71)	6.67	27	(60)
61	Medina Cnty STP 200	OH	Erie	8	(2.1)	34	(75)	4.10	26	(57)
62	Medina Cnty STP 100	OH	Erie	6	(1.6)	31	(68)	5.60	26	(57)
63	Vermilion STP	OH	Erie	6	(1.6)	31	(68)	5.29	25	(55)
64	Highland Creek STP	ON	Ontario	127	(33.5)	152	(335)	1.20	25	(55)
65	Lowville STP	NY	Ontario	4	(1.1)	27	(60)	6.86	23	(51)
66	Napanee STP	ON	Ontario	6	(1.6)	29	(64)	4.93	23	(51)
67	Rochester STP (Frank Van Lare)	NY	Ontario	313	(82.7)	336	(741)	1.07	23	(51)
68	Sudbury STP	ON	Huron	46	(12.1)	69	(152)	1.49	23	(51)
69	South Haven STP	MI	Michigan	7	(1.8)	29	(64)	4.33	22	(49)
70	Racine Water Wastewater Util.	WI	Michigan	96	(25.4)	117	(258)	1.22	21	(46)
71	Strongsville	OH	Erie	6	(1.6)	26	(57)	4.64	21	(46)
72	Geneva Mars STP	NY	Ontario	30	(3.4)	33	(73)	2.57	20	(44)
73	Meadowbrook STP	NY	Ontario	23	(6.1)	42	(93)	1.87	20	(44)
74	Archbold STP	OH	Erie	6	(1.6)	25	(55)	4.13	19	(42)
75	Brockville STP	ON	St.Lawre	17	(45.0)	35	(77)	2.09	18	(40)
76	Summit Cnty STP #6	OH	Erie	5	(1.3)	23	(51)	4.55	18	(40)

RANK	FACILITY	JURIS-DICTION	BASIN	FLOW 10^3 M^3/D)	(MG/D*)	P-LOAD KG/D	(LB/D)	P-CONC MG/L	RANKED LOAD KG/D	(LB/D)
77	Trenton STP	MI	Erie	24	(6.3)	41	(90)	1.74	17	(37)
78	Elkhart STP	IN	Michigan	56	(14.8)	73	(161)	1.31	17	(37)
79	Norwalk STP	OH	Erie	8	(2.1)	25	(55)	3.19	17	(37)
80	Port Huron, STP	MI	Erie	41	(10.8)	58	(128)	1.40	17	(37)
81	Summit Cnty STP #5	OH	Erie	30	(7.9)	45	(99)	1.49	15	(33)
82	Willoughby-E Lake STP	OH	Erie	26	(6.9)	40	(88)	1.57	15	(33)
83	Webster Central STP Plan	NY	Ontario	9	(2.4)	23	(51)	2.62	14	(31)
84	St. Thomas STP	ON	Erie	19	(5.0)	33	(73)	1.75	14	(31)
85	Oregon STP	OH	Erie	10	(2.6)	24	(53)	2.34	14	(31)
86	Ludington STP	MI	Michigan	8	(2.1)	21	(46)	2.65	13	(29)
87	Collingwood STP	ON	Huron	14	(3.7)	26	(57)	1.93	13	(29)
88	Southwest STP	ON	Ontario	32	(8.5)	44	(97)	1.40	13	(29)
89	Kitchener STP	ON	Erie	60	(15.8)	72	(159)	1.20	12	(26)
90	Lackawanna STP	NY	Erie	13	(3.4)	25	(55)	1.92	12	(26)
91	Hillsdale STP	MI	Michigan	6	(1.6)	18	(40)	3.10	12	(26)
92	Rocky River STP	OH	Erie	42	(11.1)	54	(119)	1.82	12	(26)
93	Seneca Falls STP	NY	Ontario	7	(1.8)	17	(37)	2.56	11	(24)
94	North Olmstead STP	OH	Erie	23	(6.1)	34	(75)	1.44	10	(22)
95	Ajax STP	ON	Ontario	10	(2.6)	21	(46)	1.99	10	(22)
96	Zilwaukee-Corollton Twp.	MI	Huron	8	(2.1)	18	(40)	2.32	10	(22)
97	Walkerton STP	ON	Huron	4	(1.1)	14	(31)	3.41	10	(22)
98	Medina Cnty S.D. #5	OH	Erie	6	(1.6)	16	(35)	2.60	10	(22)
99	Goderich STP	OH	Huron	6	(1.6)	16	(35)	2.54	10	(22)
100	Wayne Co. DPW-Trenton STP	MI	Erie	19	(5.0)	29	(64)	1.50	10	(22)
101	Big Rapids STP	MI	Michigan	6	(1.6)	15	(33)	2.53	9	(20)
102	Gananoque STP	ON	St. Lawre	5	(1.3)	14	(31)	2.86	9	(20)
103	Brantford STP	ON	Erie	46	(12.1)	56	(123)	1.20	9	(20)
104	Fort Erie STP	ON	Ontario	11	(2.9)	20	(44)	1.79	9	(20)
105	Dresden STP	ON	Erie	6	(1.6)	15	(33)	2.52	9	(20)
106	Fostoria STP	OH	Erie	14	(3.2)	23	(51)	1.62	9	(20)
107	Ypsilanti Comm. Utilities STP	MI	Erie	21	(5.5)	29	(64)	1.42	9	(20)
108	Saline STP	MI	Erie	5	(1.3)	14	(31)	2.63	8	(18)
109	Paw Paw Lake STP	MI	Michigan	7	(1.8)	15	(33)	2.17	8	(18)
110	Tillsonburg STP	ON	Erie	5	(1.3)	13	(29)	2.80	8	(18)
111	Newark STP	NY	Ontario	7	(1.8)	15	(33)	2.14	8	(18)
112	Ashtabula STP	OH	Erie	16	(4.2)	24	(53)	1.49	8	(18)
113	Potsdam STP	NY	St. Lawre	6	(1.6)	14	(31)	2.39	8	(18)
114	Buena Vista Twp STP	MI	Huron	16	(4.2)	23	(51)	1.50	8	(18)
115	Sturgis STP	MI	Michigan	6	(1.6)	13	(29)	2.28	7	(15)

RANK	FACILITY	JURIS-DICTION	BASIN	FLOW 10^3 M^3/D	FLOW (MG/D*)	P-LOAD KG/D	P-LOAD (LB/D)	P-CONC MG/L	RANKED LOAD KG/D	RANKED LOAD (LB/D)
116	Hamburg Master S.D. Erie Co.	NY	Erie	10	(2.6)	17	(37)	1.70	7	(15)
117	North Bay STP	ON	Huron	33	(8.7)	40	(88)	1.20	7	(15)
118	Barry STP	ON	Huron	22	(5.8)	29	(64)	1.30	7	(15)
119	Berlin STP	WI	Michigan	5	(1.3)	11	(24)	2.40	6	(13)
120	Lakeview STP	ON	Ontario	171	(45.1)	177	(390)	1.04	6	(13)
121	Depere STP	WI	Michigan	9	(2.4)	15	(33)	1.62	6	(13)
122	Milton STP	ON	Ontario	7	(1.8)	12	(26)	1.79	5	(11)
123	Colbourg STP	ON	Ontario	14	(3.7)	19	(42)	1.40	5	(11)
124	Maumee River STP	OH	Erie	21	(5.5)	26	(57)	1.24	5	(11)
125	Menomonee STP	MI	Michigan	9	(2.4)	14	(31)	1.60	5	(11)
126	London Adelaide STP	ON	Erie	13	(3.4)	18	(40)	1.37	5	(11)
127	Nellsville STP	NY	Ontario	6	(1.6)	11	(24)	1.85	5	(11)
128	Chatham STP	ON	Erie	23	(6.0)	27	(60)	1.20	5	(11)
129	Amherstburg STP	ON	Erie	4	(1.1)	9	(20)	2.10	5	(11)
130	Peterbourgh STP	ON	Ontario	44	(11.6)	48	(106)	1.10	4	(9)
131	Simcoe STP	ON	Erie	11	(2.9)	15	(33)	1.39	4	(9)
132	Amherst STP	OH	Erie	5	(1.3)	9	(20)	1.87	4	(9)
133	Bedford STP	OH	Erie	9	(2.4)	13	(29)	1.47	4	(9)
134	Ravenna STP	OH	Erie	7	(1.8)	11	(24)	1.56	4	(9)
135	Manistique STP	MI	Michigan	7	(1.8)	11	(24)	1.54	4	(9)
136	Benton Harbour St. Jos. STP	MI	Michigan	35	(9.2)	38	(84)	1.09	3	(7)
137	Owen Sound STP	ON	Huron	19	(5.0)	22	(49)	1.16	3	(7)
138	Medina Cnty STP 300	OH	Erie	13	(3.4)	16	(35)	1.20	3	(7)
139	Two Rivers STP	WI	Michigan	8	(2.1)	11	(24)	1.32	3	(7)
140	Van Wert STP	OH	Erie	11	(2.9)	13	(29)	1.22	2	(4)
141	East Aurora STP	NY	Ontario	8	(2.1)	10	(22)	1.32	2	(4)
142	Lake Co. Madison S.D.	OH	Erie	6	(1.6)	8	(18)	1.37	2	(4)
143	Fremont STP	OH	Erie	18	(4.8)	20	(44)	1.11	2	(4)
144	Bowling Green STP	OH	Erie	16	(4.2)	18	(40)	1.13	2	(4)
145	Fond du Lac STP	WI	Michigan	22	(5.8)	24	(53)	1.08	2	(4)
146	Fredonia STP	NY	Erie	15	(4.0)	17	(37)	1.12	2	(4)
147	Wallaceburg STP	ON	Erie	5	(1.3)	6	(13)	1.31	1	(2)
148	Munroe Co. STP-N.W. Quad Plt	NY	Ontario	44	(11.6)	45	(99)	1.03	1	(2)
149	West Bend STP	WI	Michigan	16	(4.2)	17	(37)	1.08	1	(2)
150	Orillia STP	ON	Huron	14	(3.7)	15	(33)	1.10	1	(2)
151	Bedford Heights STP	OH	Erie	9	(2.4)	11	(24)	1.13	1	(2)
152	South Milwaukee STP	WI	Michigan	11	(2.9)	12	(26)	1.10	1	(2)
153	Bowmanville STP	ON	Ontario	6	(1.6)	7	(15)	1.19	1	(2)
154	Crystal Beach STP	ON	Erie	4	(1.1)	5	(11)	1.29	1	(2)

RANK	FACILITY	JURIS-DICTION	BASIN	FLOW 10^3 M^3/D	FLOW (MG/D*)	P-LOAD KG/D	P-LOAD (LB/D)	P-CONC MG/L	RANKED LOAD KG/D	RANKED LOAD (LB/D)
155	Lindsay STP	ON	Erie	10	(2.6)	11	(24)	1.11	1	(2)
156	Menomonee Falls STP	WI	Michigan	9	(2.4)	10	(22)	1.10	0.9	(2)
157	Delta Twp STP	MI	Michigan	9	(2.4)	10	(22)	1.10	0.9	(2)
158	Marine City STP	MI	Erie	4	(1.1)	5	(11)	1.20	0.8	(1.8)
159	Pugsley STP	ON	Ontario	8	(2.1)	9	(20)	1.10	0.8	(1.8)
160	Dundas STP	ON	Ontario	8	(2.1)	8	(18)	1.09	0.7	(1.5)
161	Grandville STP	MI	Michigan	9	(2.4)	10	(22)	1.08	0.7	(1.5)
162	Escanaba STP	MI	Michigan	7	(1.8)	7	(15)	1.10	0.7	(1.5)
163	Oberlin STP	OH	Erie	5	(1.3)	6	(13)	1.13	0.7	(1.5)
164	Port Washington STP	WI	Michigan	5	(1.3)	6	(13)	1.12	0.6	(1.3)
165	Green Bay STP	WI	Michigan	125	(33.0)	125	(276)	1.00	0.1	(0.2)
166	Twinsburg STP	OH	Erie	4	(1.1)	4	(9)	1.00	0.0	(0.0)

Ranked Load - (F-Flood) - Load at 1.0 MG/L
P-Load - Reported Load in 1978
P-Conc - P-Load/Flow
Includes all municipal plants with flow greater than 3900 M^3/D
*U.S. Gallons